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SEPTEMBER 1999

RAILROAD COMMUNICATIONS:
Dispatch and connectivity issues

An INTERTEC®/PRIMEDIA Publication

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Vertex Radio Communications, the land mobile division of Yaesu, has been at the forefront of high-tech engineering and quality manufacturing for over 40 years. Always keeping customer satisfaction as their goal, the Vertex line meets the ever-growing demands of private sector, public safety, and governmental organizations.

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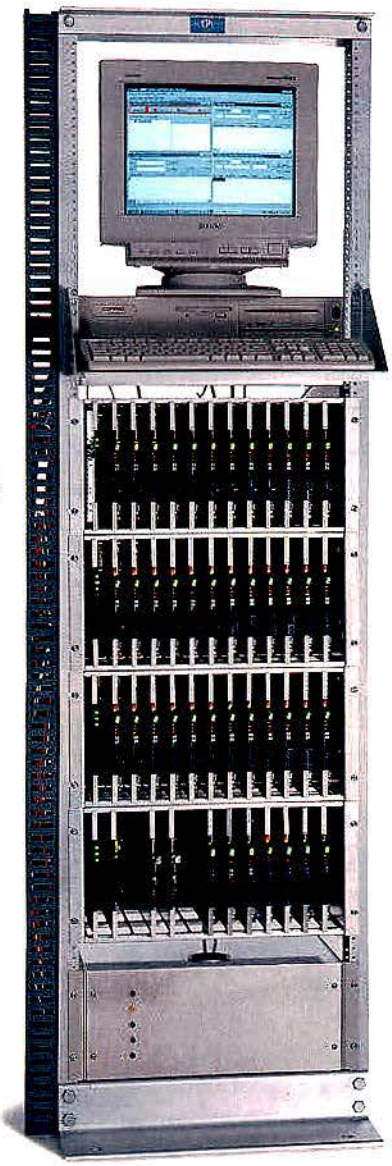

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September 1999

RAILROAD COMMUNICATIONS:
Dispatch and connectivity issues

On the cover: Land mobile radio continues to ensure safety and efficiency for the rail transportation industry. See stories on pages 22 and 32. *Cover design by Scott Dolash, art director. Inset photography by Donald E. Koehler.*

features

departments

Vol. 17, Issue 9. Mobile Radio Technology (ISSN 0745-7626) is published monthly by Intertec Publishing, 9800 Metcalf Ave., Overland Park, KS 66212-2215, and is mailed for free to qualified subscribers within the United States and Canada. Periodicals postage paid at Shawnee Mission, KS, and additional mailing offices. Canada Post Publications Mail (Canadian Distribution) Sales Agreement No. 0956309.
POSTMASTER: Send address changes to Mobile Radio Technology, P.O. Box 12960, Overland Park, KS 66282-2960.
SUBSCRIPTIONS: Non-qualified subscribers may subscribe at the following rates: United States and Canada: one-year: $35. Qualified and non-qualified subscribers in all other countries: one-year: $45 (surface mail); $105 (air mail). Subscription information: P.O. Box 12960, Overland Park, KS, 66282-2960.

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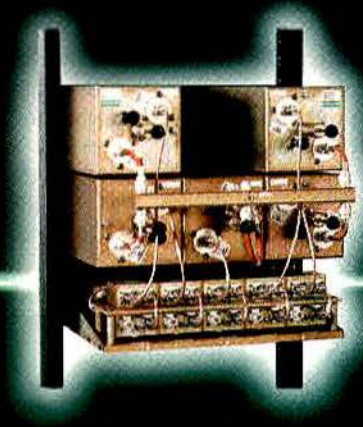

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Scanning . . .

Inquiring minds

"How is the two-way radio communications industry doing?"

Everyone wants to know. Our publisher. Our division vice president. Current and prospective advertisers.

Product flow gives an indication. So does profitability.

With respect to product flow, for example, manufacturers' representatives tell us that they are selling as much two-way radio product as they ever did, but to fewer dealers.

With respect to profitability, telecommunications attorneys tell us that their dealer clients are making more money than ever. They also tell us that dealers find it difficult to make their business grow in the face of spectrum shortages, freezes, refarming and auctions.

Dealers tell us that they continue to sell and to support large systems, but that cellular, PCS and ESMR continue to churn away customers who only use a few mobiles or portables.

Market research companies say that two-way radio sales continue to grow, although at a relatively slow rate, compared to wireless telephones.

Why, then, do some manufacturers tell us that the industry is sick?

One veteran industry "Zorro," who asked that we not peek under his mask, said that manufacturer profitability is being squeezed by rapid product obsolescence. Where dealers are maintaining their margins, manufacturers are losing theirs to retooling costs and shortened product life cycles. With fewer years over which to amortize development and retooling costs, manufacturers can find themselves in the position of making as much—or more—product and earning less profit.

While new products lose their appeal more rapidly because of subsequent product introductions, installed products last longer. Radio failure is down from 10% to 3%. Warranties are up from one year to as much as five years.

What's ahead as multiple small radio manufacturers encounter tough times despite continuing sales? It could be *consolidation.*

Name game

Transcrypt International, Lincoln, NE, has two business segments, one that focuses on secure communications modes, and another that focuses on radio communications systems. The company had been using its corporate name, Transcrypt International, to identify its secure communications mode business. In mid-July, it gave that business segment a separate identity as "Transcrypt Secure Technologies."

Its radio communications systems subsidiary uses the name EFJohnson

and traces its roots to the former E. F. Johnson Company of Waseca, MN.

Transcrypt International announced on July 29 that it had retained ING Barings as its financial advisor to assist in its review of "strategic and financial alternatives." Those codewords sometimes mean that either someone has approached a company about a buyout, or that a company is considering whether to offer its entire business or parts of its business for sale.

Whether Transcrypt International will sell EFJohnson and continue as Transcrypt Secure Technologies surely depends on how much someone would be willing to pay. With a memorandum of understanding having been signed with lead plaintiff's counsel to settle pending stockholder class-action lawsuits against Transcrypt International, the way seems more clear for someone to buy EFJohnson.

Several years ago, it looked as though UK-based Securicor might have been poised to buy the radio manufacturing company. Today, in addition to its own products, EFJohnson makes radios for Intek Global. Securicor owns 62% of Intek Global's stock and has lent the company $84 million. Intek Global will become a subsidiary of Securicor if and when a tender offer for Intek Global's stock and a proposed merger between Intek Global and Securicor are completed—maybe by the time this reaches print. Securicor might want to own the manufacturing operations on which it depends for large-volume production of linear modulation (LM) radios. Those radios serve Intek Global's own 220MHz network and similar networks owned by National Rural Telecommunications Cooperative (NRTC) members, and a few others.

Others may be looking to buy EFJohnson, too.

Transcrypt International has taken aggressive steps to raise cash to recover from business reversals, including the sale of its real estate for millions of dollars. If the sale of EFJohnson is a sensible "strategic and financial alternative," it may happen soon. And the buyer may not be the obvious possibility.

Thanks, Matt

We were fortunate in August to have the assistance of Matt Halverson, a journalism student at the University of Wisconsin at Madison, who helped us as an editorial intern. He had worked as both a general assignment and a crime-security beat reporter for the independent, advertiser-supported *Badger Herald* student newspaper. Drawing on that experience, he wrote news and features for us. He has returned to UW for his senior year. Thanks for the help, Matt, and good luck with your continuing studies.

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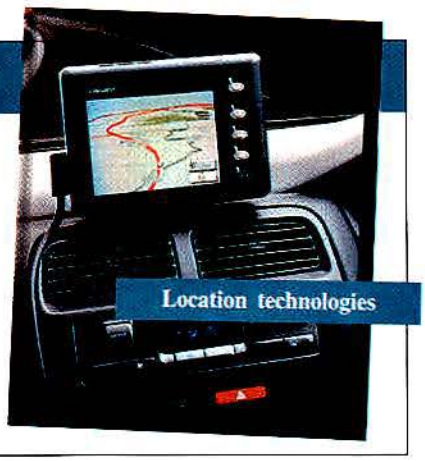
NEXT MONTH – OCTOBER 1999

FEATURES AND NEWS: System upgrades; location technologies; protecting equipment from voltage surges; APCO post-show.

PLUS: Robert H. Schwaninger Jr.'s "In the Public Interest"; editorial commentary from Don Bishop and David Keckler; what's new in hand-held radios.

AND IN THE MONTHS TO COME: Test equipment; installation and maintenance; benchtop focus; Buyers' Guide.



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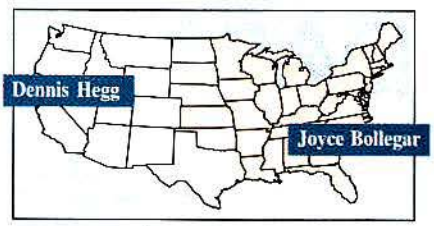

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SRM-30	25	30	3½ x 19 x 9⅝	7.0

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MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25	20	25	3½ x 19 x 9⅝	6.5
SRM-30	25	30	3½ x 19 x 9⅝	7.0

MODEL SRM-30M-2

2 ea SWITCHING POWER SUPPLIES ON ONE RACK PANEL

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25A-2	20	25	3½ x 19 x 9⅝	10.5
SRM-30A-2	25	30	3½ x 19 x 9⅝	11.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M-2	20	25	3½ x 19 x 9⅝	10.5
SRM-30M-2	25	30	3½ x 19 x 9⅝	11.0

MODEL SS-12SM/GTX

MODEL SS-IDEFJ-98

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SS-18EFJ
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SS-12MC
SS-10MG, SS-12MG
SS-101F, SS-121F
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SS-10SM/GTX
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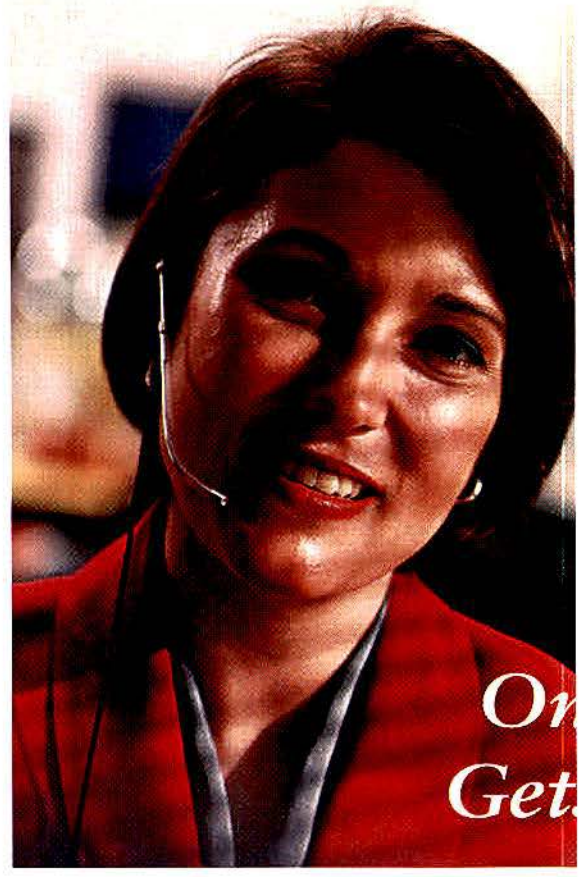

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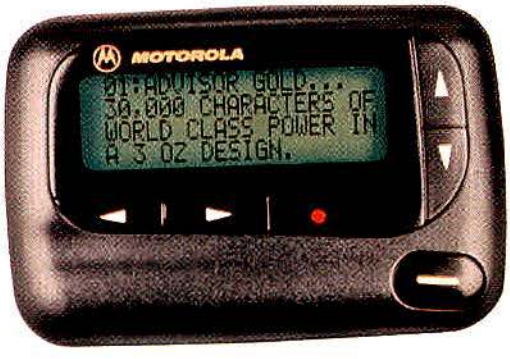

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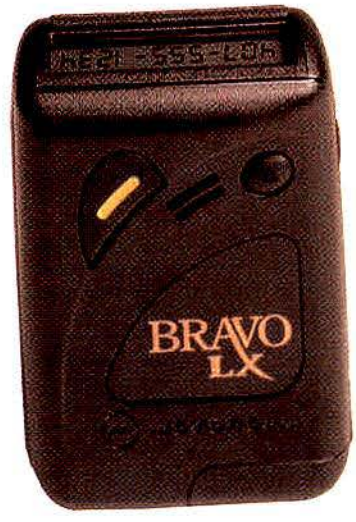

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calendar

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19–22: Fall Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Amsterdam, The Netherlands. Contact: 904-322-2500.

23–25: Personal Communications Showcase, sponsored by Personal Communications Industry Association, New Orleans. Contact: 703-739-0300 or Web site www.pcs99.com.

28: Universal Licensing System seminar, sponsored by the Chicago Office of Emergency Communications, the Association of Public Safety Communication Officials–International (APCO) and the FCC, ChicagoOffice of Emergency Communications, Chicago. Contact: 312-746-9257 or email: moapco@worldnet.att.net.

October

12–13: Advanced RF Safety Training, sponsored by RF Emission Measurements, Richardson, TX. Contact: 817-312-5363.

14–15: Small Business in Telecommunications National Conference. Regal River Front Hotel and Convention Center, St. Louis. Contact: 520-423-2205.

18–21: Annual APCO Canada Conference, sponsored by APCO, New Brunswick, Canada. Contact: Jim Flanagan at 888-226-2726.

25–26: Annual Telecom Summit, sponsored by The Strategis Group, Hyatt Regency Gainey Ranch, Scottsdale, AZ. Contact: 202-530-7602.

27–30: Industrial Telecommunication Association/USMSS Joint Conference, sponsored by ITA and USMSS, Grand Hyatt, Washington. Contact: 703-528-5115 or Web site www.ita-relay.com.

November

1–4: Telecommunications Resellers Assocation Fall Conference and Exposition, sponsored by TRA, Dallas. Contact: 202-835-9898 or Web site www.tra.org.

2–4: Wireless I.T., sponsored by the Cellular Telecommunications Industry Association, Santa Clara Convention Center, Silicon Valley, CA. Contact: 202-785-2842 or Web site www.wow-com.com.

8–9: ENTELEC & UTC Joint Fall Seminar, JW Marriott, Houston. Contact: 888-503-8700 or email entelec@pdq.net.

10–14: Communications Marketing Conference, sponsored by the Communications Marketing Association, Harvey Hotel, Dallas. Contact: Jack Armstrong, 410-308-0808.

15–16: AMTEX, sponsored by the American Mobile Telecommunications Association, Hilton, Walt Disney World Village, Lake Buena Vista, FL. Contact: 202-331-7773 or Web site www.amtex.org.au.

15–16: Fourth International Congress on Commercial Trunked Radio, sponsored by the International Mobile Telecommunications Association, Hilton, Walt Disney World Village, Lake Buena Vista, FL. Contact: 202-331-7773.

16–17: Advanced RF Safety Training, sponsored by RF Emission Measurements, Southlake, TX. Contact: 817-312-5363.

17–19: TelecomLatina, co-sponsored by *Mobile Radio Technology*, Miami Beach Convention Center, Miami. Contact: 800-288-8606 or Web site www.telecomlatina.com.

19: Radio Club of America Communications Symposium, 91st Anniversary Dinner and Awards Presentation. New York Athletic Club, New York. Contact: Gerri Hopkins, 732-842-5070.

2000

February

28–March 1: Wireless 2000, sponsored by the Cellular Telecommunications Industry Association, Ernest Morial Convention Center, New Orleans. Contact: 202-785-0081 or Web site www.wow-com.com.

March

19–22: ENTELEC, sponsored by ENTELEC, Dallas Convention Center, Dallas. Contact: 281-357-8700 or Web site www.entelec.org.

22–24: International Wireless Communications Expo, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606.

May

8–11: Telecommunications Resellers Association Spring Conference and Exposition. Philadelphia Marriott. Contact: 202-835-9898 or Web site www.tra.org.

15–18: Spring Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Tokyo Pacific Hotel, Tokyo. Contact: 904-322-2500 or email matumoto@mars.yrp.nttdocomo.co.jp.

30–June 1: Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Toronto, Canada. Contact: 613-233-4888, ext. 102, or Web site www.cwta.ca.

June

4–8: Supercomm, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. Contact: 800-278-7372.

25–29: UTC Telecom, sponsored by UTC, The United Telecom Council, Phoenix. Contact: 202-857-1881 or Web site www.utc.org.

August

13–17: Association of Public-Safety Communications Officials—International (APCO) National Conference, Boston. Contact: 904-322-2500 or Web site www.apcointl.org.

editorial index

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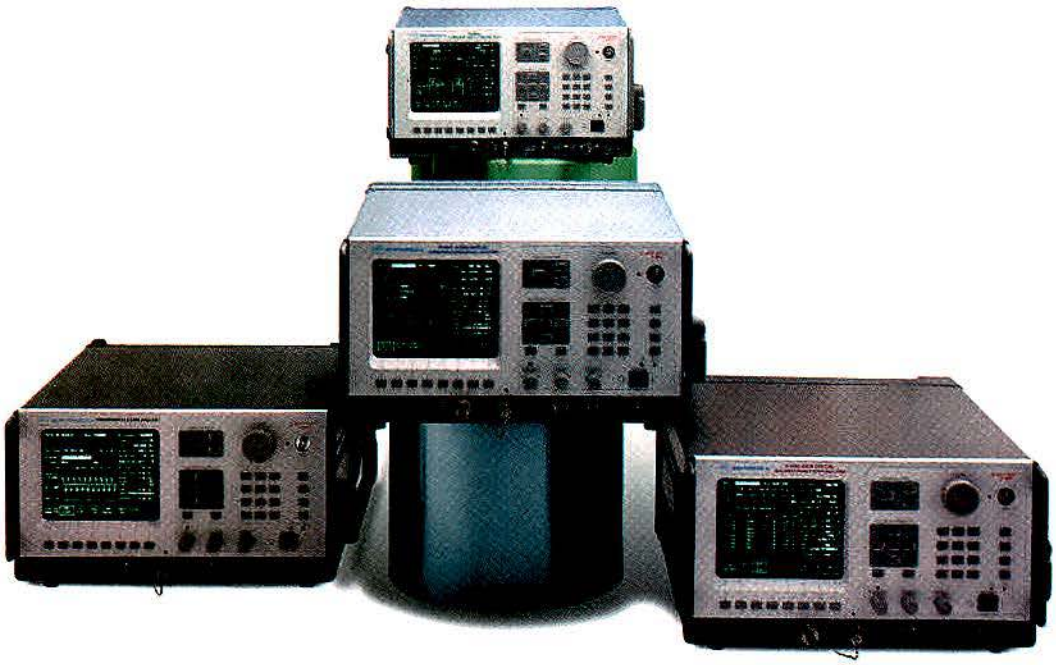

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MOTOROLA

Can't we all just get along?

NIMBY (not-in-my-backyard) is a problem that site operators and owners have had to face from the beginning. It's even happening in Washington, and everyone is getting involved, including Congress and a Hollywood actress. Except in this case, it is NIMP (not-in-my-park).

Rock Creek Park, a heavily wooded valley running through northwest Washington, is an island of nature in a town of monuments, subways and politicians. It is also an island without complete cellular coverage. So Bell Atlantic Mobile wants two new antenna towers in the park, a 100-foot monopole at the tennis center to replace an existing 38-foot tower and a 130-foot tower at the maintenance center.

Arguments against erecting the towers are that residents say the towers intrude on natural splendor (the term "eyesore" was used), and they are a health hazard. At a demonstration outside the U.S. Interior Department (DOI), actress Linda Evans said that the residents had a "right to say that they don't want to be radiated 24-hours-a-day in that park." (DOI has jurisdiction over capital park lands.)

Radiated? Towers aren't ray guns (or sun lamps). The park service's environmental assessment concluded that the towers posed "no significant environmental impact." And beauty is in the eye of the beholder.

This is not only about NIMP. The situation is reminiscent of kindergarten fights over the ownership of toys. While Washington's National Capital Planning Commission (NCPC) voted on July 1 to further delay the siting of the two towers (after a five-year delay), the *Senate* was voting to override the NCPC.

The biggest disagreement is over who has what right. Senate Minority Leader Tom Daschle (D-SD) amended the DC budget bill to give the U.S. Park Service 90 days to approve the project, thus taking the decision away from the NCPC. He said that "people ought to have the right" to use cellular communications when in danger. Daschle cited the Telecommunications Act of 1996, saying that it "specifically requires that federal property be made available to services for wireless communication if those services are responsible and environmentally sound." According to Daschle, 348 violent crimes occurred in the park in the past five years.

I understand the zoning concerns, but I'm also afraid of BANN (build-absolutely-nothing-nowhere). Quit haggling and *compromise*. If District leaders really looked at the evidence, they would see that radiation is not the problem. It's more dangerous to stand in front of your microwave. Violent crime *is* a problem, though, and citizens should be able to call for help in this area.

The eyesore argument holds more weight, but that's why companies such as Valmont/Microflect and Larson Group *disguise* towers (*stealth* technology). Maybe they could build an observation tower with antennas and charge $5 to look out over the park.

—Nikki Chandler
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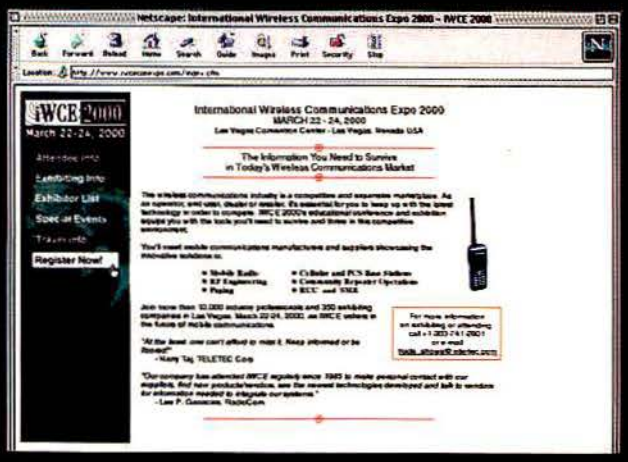

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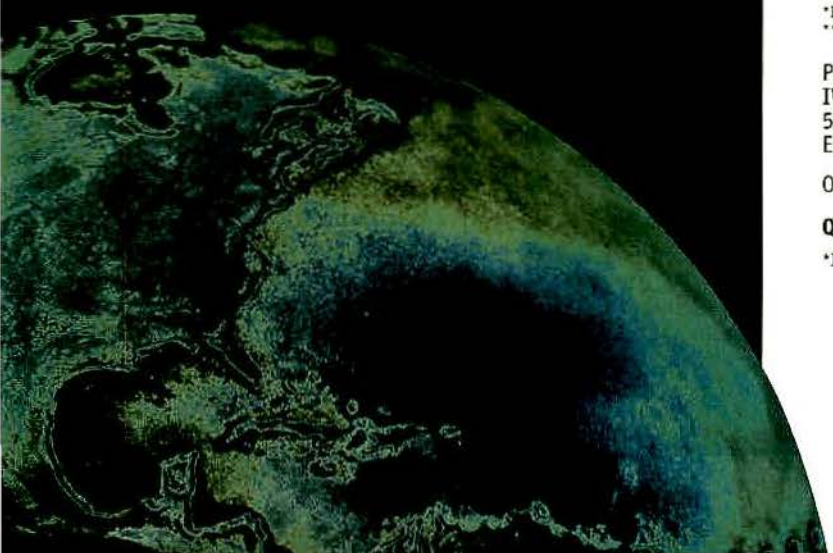

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Interference problems not new

Having worked with urban public safety 800MHz trunked systems for almost 15 years, and having been an RF systems engineer for almost 30 years, I believe the problems outlined in Joe Kuran's report ("IM/EMI Issues: A Conflict of Public Interest," *MRT*, March 1999) are really nothing new. I have known Joe for many years, and I thought he did an excellent job of documenting a problem that has not been too widespread but will get more so as the nature of radio systems change.

The basic problem is that radio sites are moving off the high mountaintops and down to the users. The cellular industry faced this problem when they started moving to lower sites. Often one carrier would put a site at a location for either better coverage or increased traffic handling. The other carrier would all of a sudden experience a large number of dropped calls in that area. The problem? Receiver overload—and these frequencies could be several megahertz apart. The solution? Well, many times the other carrier had to build a site in that immediate area to provide equal signal strength.

I was involved in a simulcast 800MHz trunked public safety radio system project a decade or so ago that had one high site and one low site. The low site was intended to provide in-building coverage and good local signal strength. When responding to a large industrial-complex fire alarm, a fire department on the system noticed its radios wouldn't work very well within a few hundred yards of that complex. The reason? The industrial company had installed their own analog trunking system and because it was operating a low site, it was running high power.

As we move into the refarming era where high sites have very low power and low sites have high-power, we are going to see more of this at VHF and UHF. As the transition occurs, some agencies will be building VHF/UHF simulcast systems using higher power, low-elevation sites. Agencies still trying to use high power on high sites will have to deal with the same thing—trying to receive signals in the −90dBm to −105dBm range in the nearby presence of signals in the −30dBm to −5dBm range. Much of the existing equipment out on the market today won't function in that environment.

As far as paying the price for better equipment? Well, if you were paying $500 for an 800MHz portable, I would agree. However, at $2,500 to $3,500 for an 800MHz portable from Motorola, I am disappointed in the radio's performance. Of course, competition isn't going to solve this problem either. If you have a Motorola trunked radio system, you are essentially stuck with Motorola mobiles and portables. Nextel is also stuck with Motorola since that is their only supplier.

We are looking to a future where the RF environment is going to be much more hostile than it has been in the past. All of us— system engineers, customers, and equipment suppliers—are going to have to design systems differently in the future, or else we will have a future like the Tower of Babel.

—Joe Blaschka Jr., P.E.
Adcomm Engineering
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Cash, campaigns and what counts

By Robert H. Schwaninger Jr.

The race for the presidency is upon us. We, the beleaguered members of the telecommunications industry, can collectively cringe under the barrage of media blitzes that each of the campaigns is churning out. We can either ignore the entire fracas until some semblance of relevance is apparent, or we can cautiously begin weeding out the "wannabes" from the "gonnabes."

On the Republican side, there is a plethora of candidates from which to choose. There's Bush without a drawl, McCain without the cash, Dole (the one without E.D.), Alexander without the flannel, Quayle without a clue, Forbes without a credit limit, Buchanan without a chance and Smith without a vote. On the Democrat side, there is Gore without Clinton and Bradley without a tissue.

Of the 10 candidates listed above (I may have missed a few candidates from the Aleutian Communist League), few will be taken seriously by the electorate. People like to vote for a winner, and the stable of party stalwarts will definitely be winnowed by primary voters, who will politely inquire: "WHAT WERE YOU THINKING ABOUT?!"

As the 10 hopefuls criss-cross the early primary states, gobbling up potato salad, barbecue and pundits, the media are tossing in their two-cents worth. Your favorite candidate may be pilloried by a scornful press looking for gaffs and guffaws to fill the front page. Your champion may also be the grateful recipient of kudos from that same press corps, which is awed by anyone who can withstand its volleys of inane questions. (Some journalists often appear to be asking questions of beauty pageant contestants rather than of the prospective leader of the free world.)

Most campaign news reported these days focuses on how much money each candidate has raised. The fun facts of financial doings among the candidates are somewhat repulsive to me. I know that running for office is a pricey business. I know that campaigns have been won and lost based on the size of a war chest. But the media's fascination with this topic is so pervasive that it leaves one with the impression that the U.S. presidency is for sale.

Don't get me wrong. Campaign finance is important, and the ability of a candidate to attract contributions from committed voters is an indicator of that candidate's viability. But the press has not reported, for example, how many of Bush's millions came from corporations that have *also* tossed money into the Gore campaign. Corporations are big on hedging their bets.

So what is the point? For the media, it's about creating a horse race with "front runners," "late bloomers" and "dark horses" to tout the race and to sell more newspapers. If there is a front runner, exciting challengers can be promoted that might knock that person out of the post position. "Winning" and "losing" can be written about in a way that focuses on the fortunes of the candidates rather than on those of the country. In the final analysis we, the American public, are the only potential winners or losers, not the candidates.

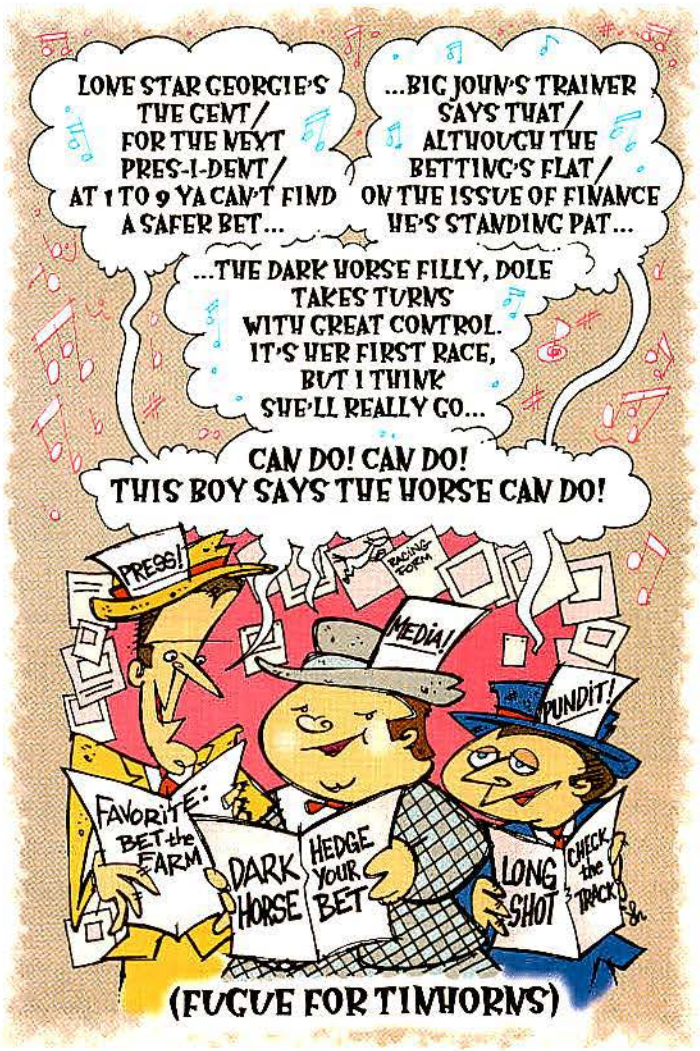

Illustration by John Hayes

At this juncture, the media have anointed Bush as the front runner for the Republicans. My polite question is a simple "Why?" No vote has been cast—or will be—for about six months. Polls have been taken, but without a clear articulation of opposing views among the candidates, what do those polls mean? Little. If Bush should declare himself in favor of "Naked Day" on the White House lawn (beats the heck out of the Easter Egg Roll), the polls could change rapidly.

So, rather than taking our cues from a manipulative media, perhaps it would be wise for us to focus on the *issues* that separate the candidates. One issue that springs to mind is campaign reform, a topic that McCain has placed on the table. McCain is looking for ways to rein in soft-money contributions to the candidates, which he believes result in the politics of special interest. His suggestion that we stem the unregulated flow of cash from political action committees and contributors,

Schwaninger, *MRT*'s regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

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laundered through the national party coffers, seems like a noble idea, albeit political heresy.

Consider the amount of money that large telecommunications corporations and industry behemoths toss at the political parties. These groups are buying wholesale what they are precluded from buying retail, one candidate at a time. This "buying-in-bulk" approach is quite effective. It gives you access to a host of politicians as a "friend of the party."

It also presumes that you would accept *any* candidate within a given party. Taken to its logical extreme, it means that if you were a Democrat you would vote for Laura Fryer for president of the United States before you would vote for George W. Bush Jr. (Laura is a fine Democratic member of the Borough Council of Lansdowne, PA; Bush is the Republican Governor of Texas.) I know Laura, and I have worked on her past campaigns. I'm just not convinced she's ready for the White House.

So, if you think that campaign reform is needed, you might lean toward the guy who's in favor of the idea. If you think that campaign reform isn't important, move onto another issue that you think *is* important. What you choose as your search criterion isn't nearly as important as a thoughtful selection process.

What most members of our industry should be looking for is a candidate who reflects our interests and values. For example, where does the candidate's record show that he or she stands on small business rights, taxes, federal agency oversight, the economy, the duties of the FCC, access to government process and a host of other issues that will define the candidates by more than their respective bank accounts?

When you examine the candidates based on a litmus test of ideas, values and priorities, your choice becomes clearer and you will be able to support a candidate, not just an image crafted from sound bites and B.S. that anyone can buy with a few million bucks of contributors' largesse.

Once you've made a selection, then *support* that candidate. I am always amused by those people who give lip service, and little else, to the political process. Any idiot can have an *opinion* about government. It takes a little more to put action behind those words and do something to get your candidates elected. So, if you've made your choice, then send that candidate a few bucks to give tangible force to your opinion. Don't let hot air be the only byproduct of your thoughtful selection.

Cash is a personal commitment *only* when the donation is one-on-one. It's only slightly about party; it's more about your expression of hope for improving government and the environment in which your business will operate. So, throw a backyard fundraiser, and invite your customers at $20 a head. Get involved in your own future.

"Wait a minute, Schwaninger! You said earlier in this column that money is the wrong litmus test of a candidate's acceptance with the voting public. Did you change your mind, like Clinton trying to decide whether the rate on the Lincoln Bedroom is for single or double occupancy?"

Let me clear that up, dear reader. Money *alone* is the wrong indicator, but the *source* of the money isn't. If your contribution to the millions it costs to run a campaign is only $10, or the cost of putting a sign on your front lawn, that's the type of grassroots politics that *counts.* ■

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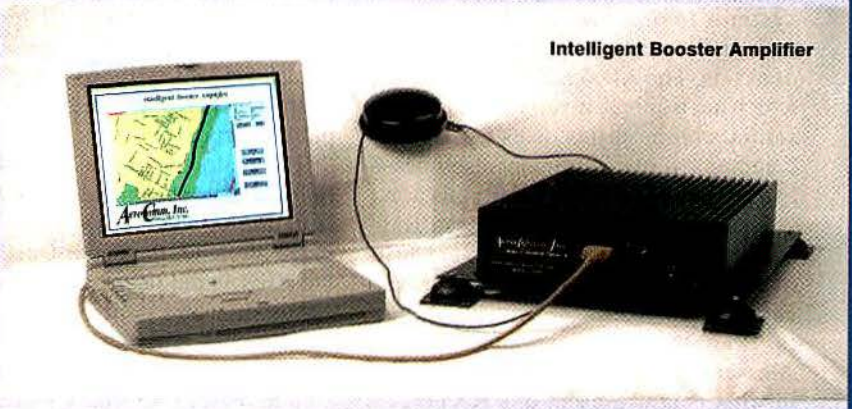

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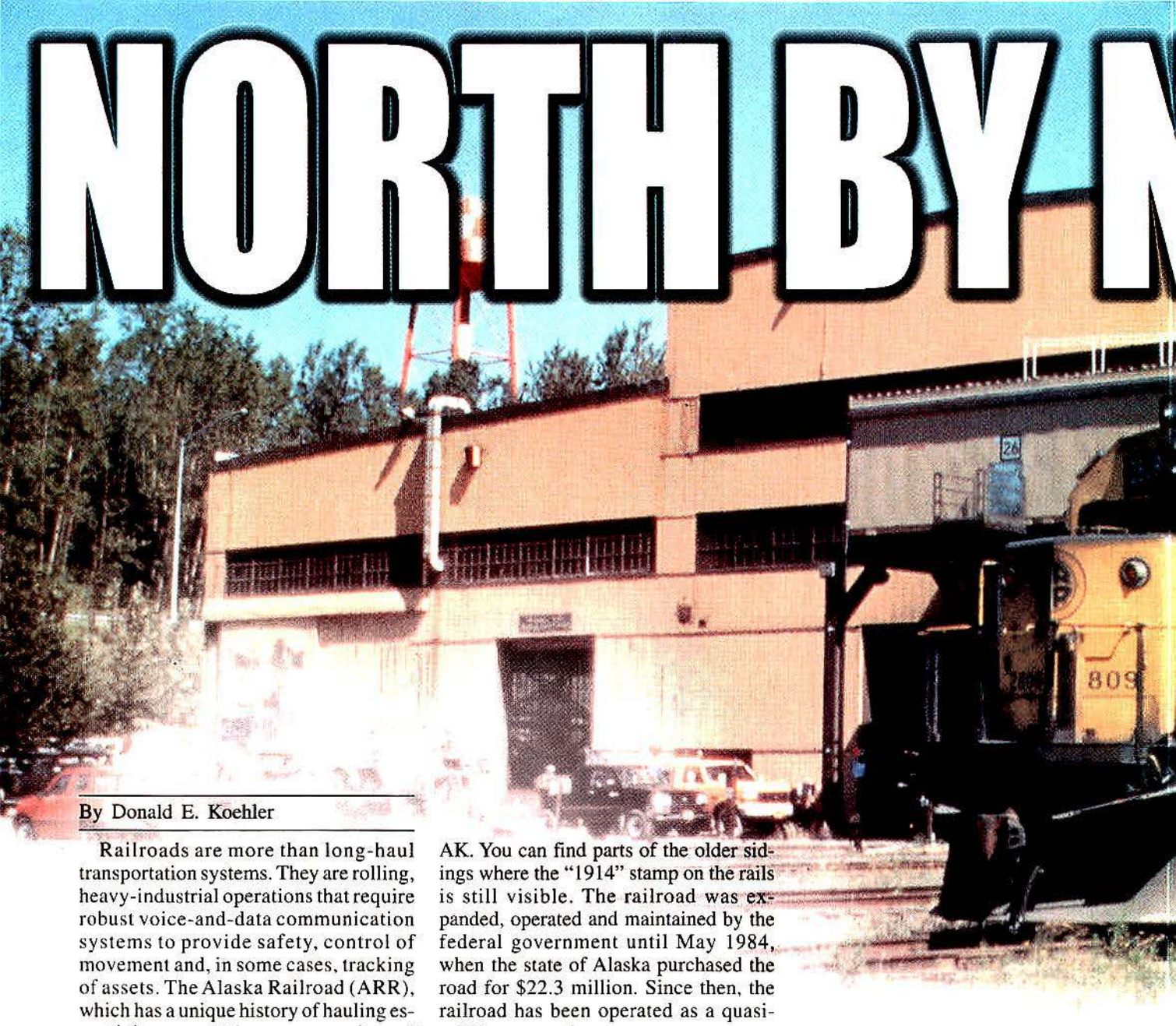


By Donald E. Koehler

Railroads are more than long-haul transportation systems. They are rolling, heavy-industrial operations that require robust voice-and-data communication systems to provide safety, control of movement and, in some cases, tracking of assets. The Alaska Railroad (ARR), which has a unique history of hauling essential commodities, uses a variety of communications equipment resources—and brands—to accomplish its mission.

From its beginning, the Alaska Railroad was literally created from leftovers. In 1917, remnants of the rail equipment used in the construction of the Panama Canal were shipped to Alaska, and the railroad was established in what is now present-day Anchorage, AK. You can find parts of the older sidings where the "1914" stamp on the rails is still visible. The railroad was expanded, operated and maintained by the federal government until May 1984, when the state of Alaska purchased the road for $22.3 million. Since then, the railroad has been operated as a quasi-public corporation.

The history and the location of this railroad have contributed to a Darwinian situation in Alaska: a species evolving in isolation. Of the major U.S. railroads, the ARR is the only one with complete ownership and control over its road, rolling stock and motive equipment. By contrast, railroads in the contiguous United States ("CONUS") share almost everything: track, equipment and rolling stock. This complicates their operations immensely.

Understanding the basics of railroad communications requires a broader overview of the industry's complex daily operations. The ARR's operations provide an ideal example because they encompass all of the elements of a larger road system—just not *as* large. (Wayside communications, track control and track signaling will not be covered. Anyone needing this obviously sensitive information should contact the railroad directly.)

The ARR, like most of the major roads, makes its money hauling freight. In Alaska, bulk commodities include gravel and refined petroleum products (gasoline and jet fuel). Containerized freight and tourism are also significant contributors to the bottom line. An intertie, via a marine link with the Canadian rail system, provides bulk rail access to the CONUS. With a relatively short (slightly less than 500 miles) main line, the ARR system has a total track length of 661 miles. Having just one main line

LMR radio sy
safety and profita

Contributing Editor Koehler has more than 30 years of experience in radio, telephony and computer electronics. He has been teaching part time at the University of Alaska, Anchorage, for the past four years.

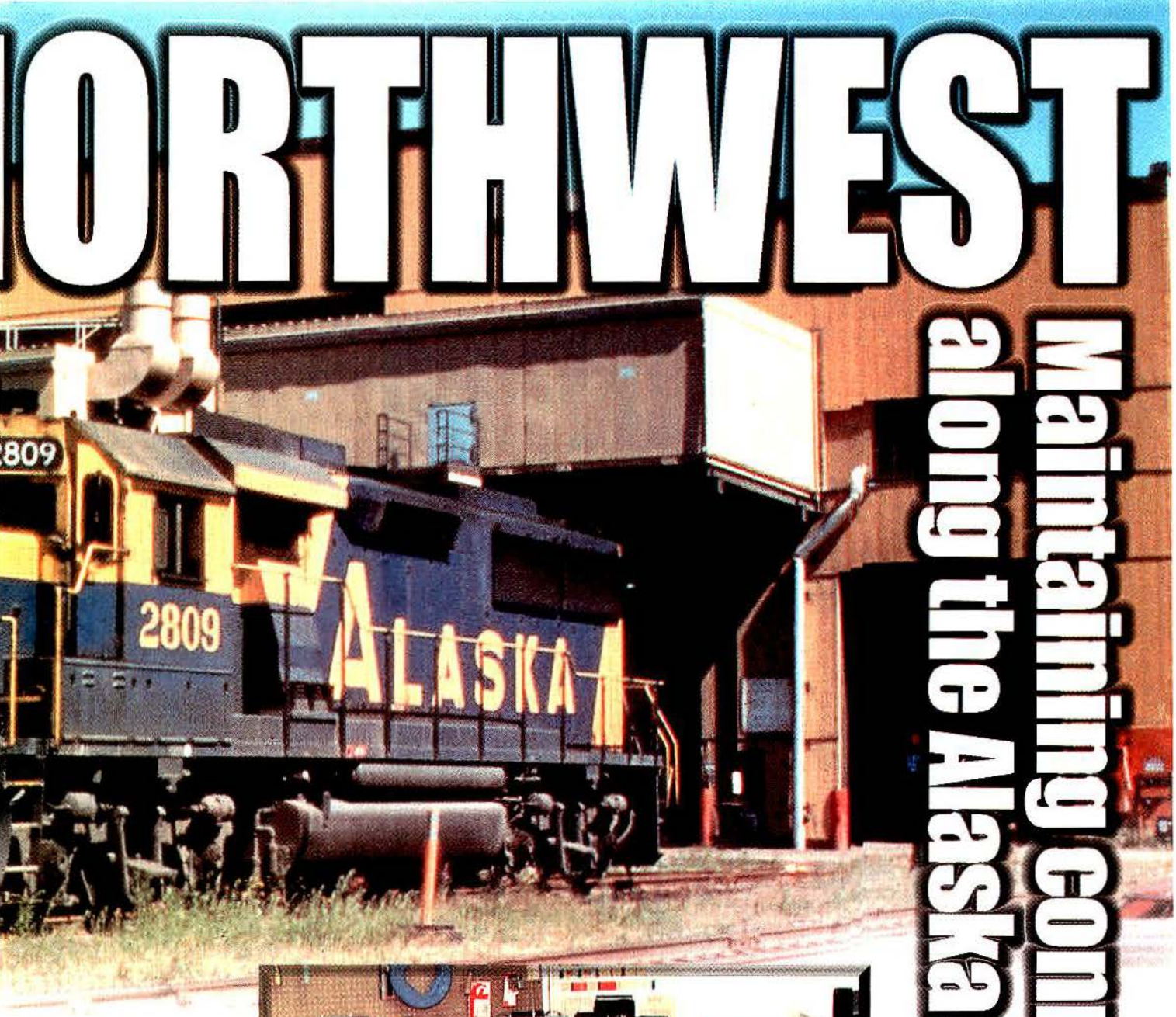
His email address is afdek1@uaa.alaska.edu.

Special thanks for the cooperation of the Alaska Railroad, particularly Scott Banks from public affairs and Bart Browning, radio shop supervisor.

You can learn more about the ARR, including a complete history, at www.akrr.com. Use the key search words "railroad safety" and "railroad communication." For fun, check out the Iditarod Trail dog race at www.iditarod.com.

NORTHWEST

Maintaining connectivity along the Alaska RR



means that sidings are spaced at about five-mile intervals. Movement control is a vital part of the total communications system.

As trains of mixed freight, or those full of tourists, travel the main line, they are shunted off onto sidings on a

Similar systems make for a compact shop area.

stems are still used in a variety of ways to improve efficiency, bility of modern railroads. The self-contained Alaska Railroad provides a model of radio systems applications.

ARR radio use procedures *(excerpts)*

2.6 Communication not understood or incomplete
An employee who does not understand a radio communication or who receives a communication that is incomplete must not act upon the communication and must treat it as if it was not sent.
EXCEPTION: An employee who receives information that may affect the safety of employees or the public or cause damage to property must take the safe course. When necessary, stop movement until the communication is understood.

2.10 Emergency calls
Emergency calls will begin with the words "Emergency—Emergency—Emergency." These calls will only be used to cover initial reports of derailments, collisions, storms, washouts, fires, track obstructions, property damage or injury to employees or the public. Emergency calls must contain as much complete information on the incident as possible.
All employees must give absolute priority to an emergency communication. Unless they are answering or aiding the emergency call, employees must not send any communication until they are certain no interference will result.

2.17 Radio testing
Radios used in train operation, outside of a yard, must be tested at the point where the train is originally made up.
Engineers and conductors must test the radios at least once during each tour of duty to verify the radios are working.
The radio test must include an exchange of voice transmissions with another radio. The test must confirm the quality of the radio's transmission.

2.18 Malfunctioning radio
Malfunctioning radios must not be used. As soon as possible, notify each crew member and the train dispatcher or other affected employees that the radio is not working.

2.19 Blasting operations
Employees must not operate radio transmitters located less than 250 feet from blasting operations.

2.20 Internal adjustments
Employees are prohibited from making internal adjustments to a railroad radio unless they are specifically authorized by the FCC or hold a current Certified Technician's Certificate. Employees authorized to make adjustments must carry their FCC operator license, Certified Technician's Certificate, or verification card while on duty.

regular basis. Coordinating this movement requires a solid communications system between the dispatch center and the train crew. This chore is handled by an all-VHF system, using a mix of repeaters and fixed base stations.

Full maintenance for rolling stock is provided in Anchorage with a yard, a roundhouse and a complete heavy-machine shop. Everything necessary to keep rolling stock and motive equipment operating on schedule, including refueling, is provided for this "closed" system. Limited maintenance is also available in Fairbanks, AK, the northern terminus of the road. Corporate offices for the system are in Anchorage, as is the dispatch center. Depots and smaller crew offices are located along the road; wire and radio communications are sourced internally.

All communications for the road system are provided by the ARR itself, a common practice of all railroads. The telephone and radio equipment is maintained by the radio shop, a small department of six employees headed by Supervisor Bart Browning. The ARR has a slightly different labor pool to draw from than CONUS railroads: The ARR hired Browning after his retirement from the U.S. Air Force. (Anchorage is

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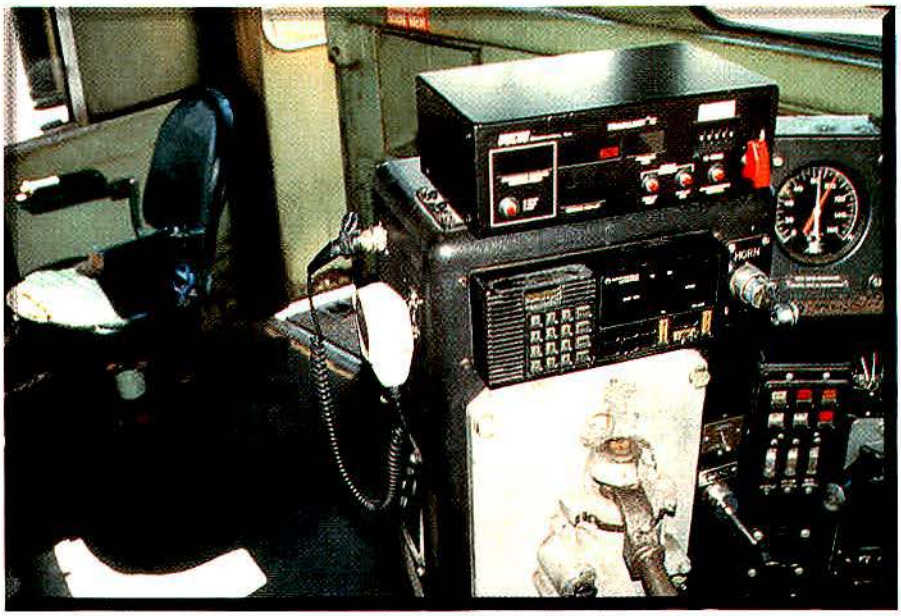

In the engineer's cab are the controls for this awesom power—and the radio that permits safe movement.

the home of Elmendorf AFB, a large military installation.) The total ARR system employs about 550 Alaskans, with the number varying with the time of the year—more in the summer tourist season, fewer in the winter.

The current radio equipment is a mixed bag: portables, mobiles, base stations and repeaters. The entire radio system is operated on VHF frequencies, with different services on different channels. The equipment comprises a variety of makes, including Motorola, Bendix-King and EFJohnson. This strange mix reflects the legacy of operations under the federal procurement system, where the low bidder got the sale.

Currently, the railroad is standardizing on Motorola equipment for several reasons. With fewer models from a single vendor, spare-part purchases and bench-stock selection are greatly simplified. Maintenance manuals and part numbers use a common format, and specialized test equipment needs are reduced. The ARR shop is responsible for more than 375 portables, 165 mobiles, 75 base stations, and 21 repeater and dispatch points, so standard systems save time and money.

Operations safety is also improved by standardized communications because employees only require training on one type of radio set, portable or mobile. For example, some time ago, ARR experienced an accident resulting in equipment loss partly because an employee was unable to operate the available mobile radio and could not contact the train crew. This operations issue is no longer a problem. The ARR has adapted a standard set of operating rules (www.akrr.com/gencode/radio.html#2.0) to further ensure that all communications are understood. (See

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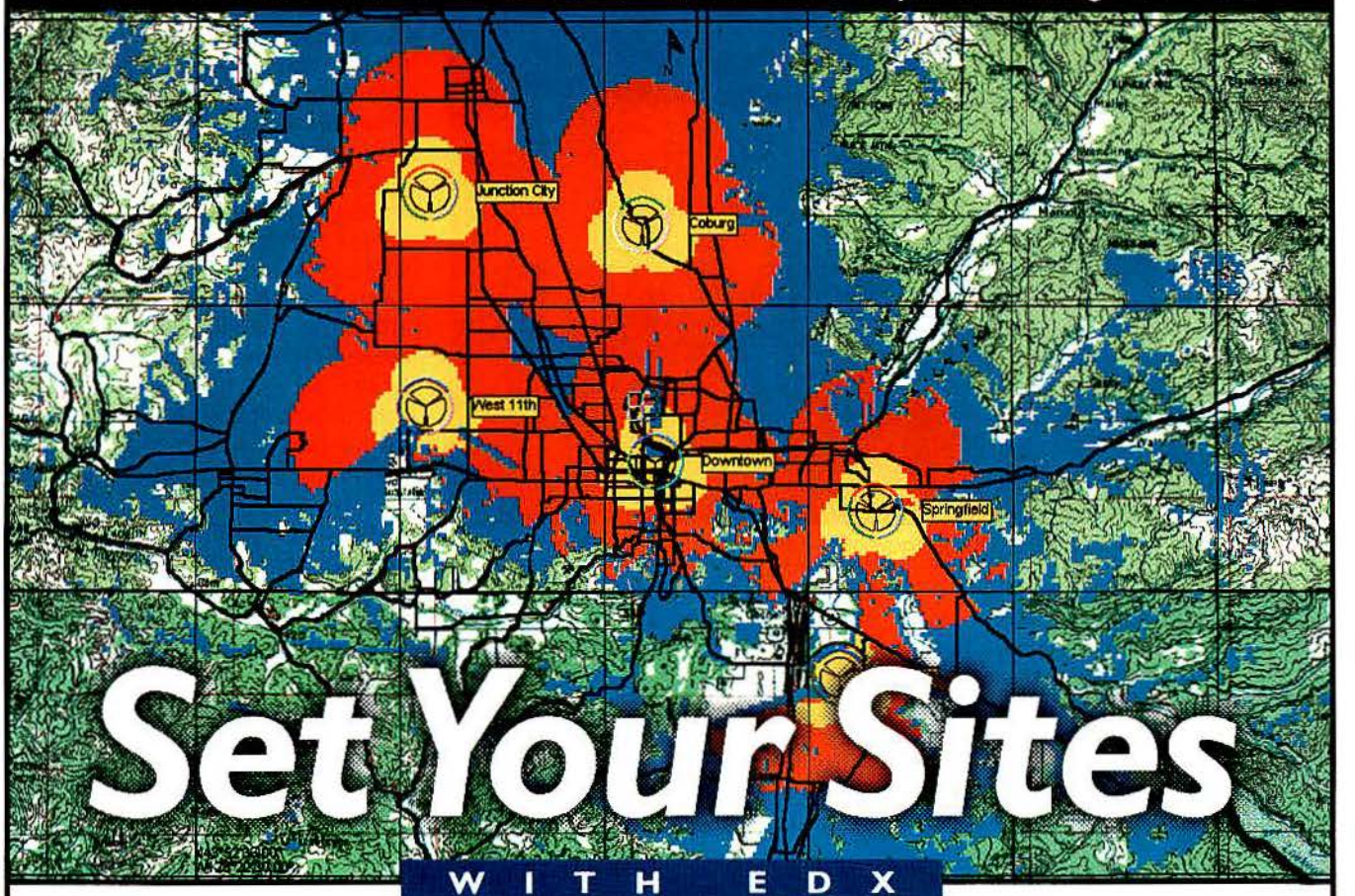

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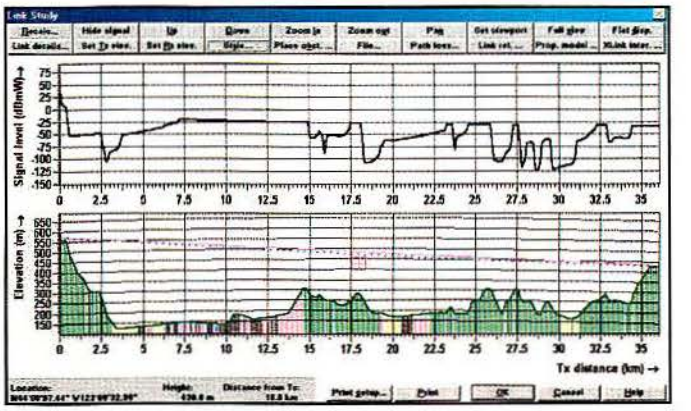

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Alaska railroad headquarters. Cargo moves by rail, and in the distance, by air.

sidebar on page 24.)

Safety communications have a separate channel with instant connection to the dispatch center. Any employee with a radio can contact the dispatcher for help at any point on the rail system. Equipment shelters along the road are also equipped with a telephone that connects directly to the dispatch center. Because of the multiple jurisdictions along the system, all 9-1-1 calls are routed directly to the Anchorage E9-1-1 operator. The PSAP can then determine the most appropriate responding agency and alert it to the problem. The Municipality of Anchorage and the railroad have worked together to ensure that maps, shelter locations and types of potential emergencies are well-understood by the E9-1-1 dispatchers.

Because of Alaska's climate, tracks take a beating; minor derailments are not uncommon. The response crews have their own channel to ensure clear communications and to allow other system work to go on without interference. A system of base stations and repeaters covering the length of the system provides movement control. The track signaling system is just a part of the total control on the movement of trains within the system. ARR will soon be testing a GPS and data system. The goal for the test system is to allow tighter management of train locations, thus allowing more trains to be active at one time while maintaining the necessary safe-distance separation.

The biggest problems faced by the radio shop are those common to many LMR dealers and service shops. Extreme cold is no joke in Alaska. In −40° weather, portable radio batteries last less than half the time normally experienced in the summer. Although equipment shelters are equipped with gang chargers, the batteries may circulate among users without being reconditioned for some time before

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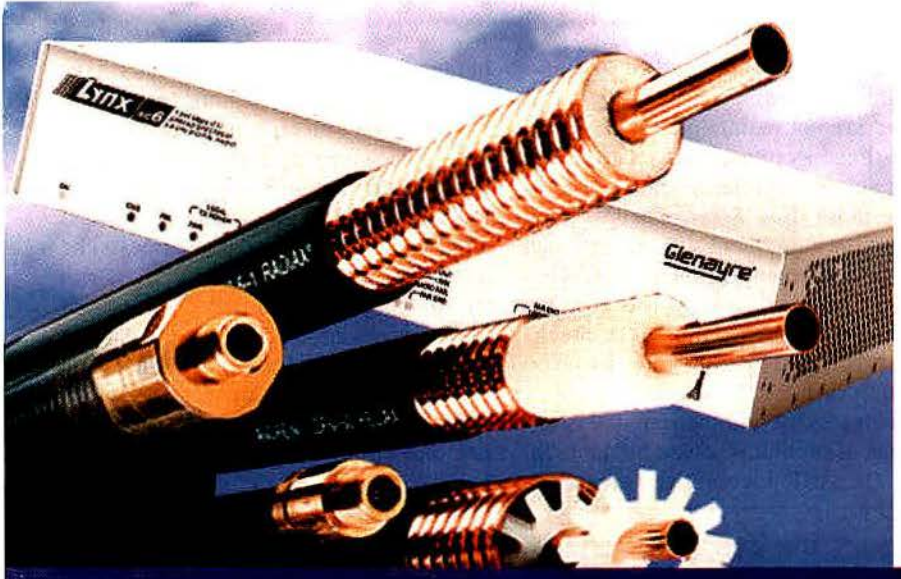

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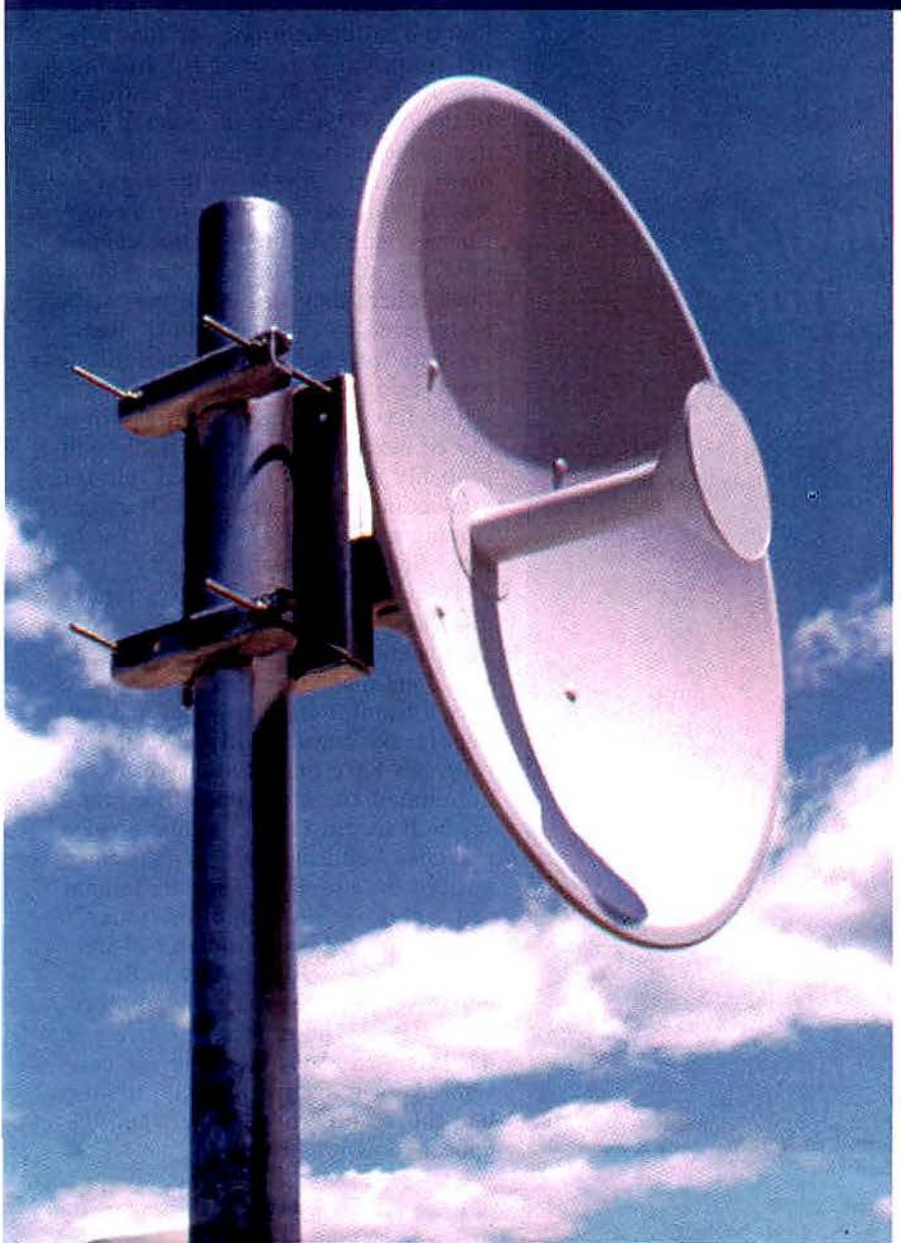

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showing up in Anchorage. Although ARR trialed one battery management system, the value vs. the cost showed the current procedure is the best tradeoff. Batteries are also being changed out for nickel-metal hydride (NiMH) types to obtain better cold-weather performance.

Signal fade is another problem crews face as they navigate the road. The dispatcher can account for well-known "soft spots" in the system coverage as trains move along the system. The track system parallels the highway system in some spots, but it is isolated for the bulk of the route.

Although crossing-guard barriers and signage are not maintained by the radio shop, these systems do use alternate power sources similar to those used by remote radio sites. Solar panels sit atop many of the equipment shelters and road crossing equipment cabinets. Wind generators power some of these systems near Windy Pass, famous as a checkpoint in the 1,049-mile-long Iditarod Trail dog race.

Rough service and interference is another set of problems solved by the radio shop. The ARR locomotives create the harshest radio environment that I have observed. Train engines are technically called "diesel-electric traction locomotives" because they are moved by powerful electric motors. There are huge motor-generators under the sheet-metal cowlings of these giant machines. The polyphase, ac generator output is run through massive control circuits and then fed into large ac motors attached to the road trucks. Imagine installing a radio within a couple of feet of a multi-hundred-kilowatt generator set! If that is not bad enough, the radio sets take a beating from the vibrations produced by the diesel motors and travel over the rail joints. The ARR uses Motorola Spectra radios designed for this destructive environment. Browning said excellent results have been achieved with these sets. Minimal maintenance is required, and the sets are easy for the crews to operate, he said.

An internal system of repeaters and base stations allows open telephone interconnection. These radio sites are also connected by land lines that follow the railbed. In one section, a fiber-optic cable is used for linking. The ARR, as well as many railroads in the CONUS, have discovered hidden value in their system railbeds. In many places, access to the right of way is sold as a pathway for modern fiber systems. As this practice continues, the old, open-wire telephone lines, where they still exist, may soon be replaced by fiber-optic links. Radio systems for communications links—even microwave—cannot compete with fixed communication lines placed next to the roadbed. Radio will probably retain its traditional role for crew communications, as well as becoming a "gap filler" where access to fixed lines is impractical.

There are several other uses for radio links in modern rail systems. Asset tracking within the ARR system is still done manually because there are only a handful of cargo types and few depots. By contrast, in the CONUS, railroads have made extensive use of automated tracking of rolling stock for both security and customer service reasons. Additionally, you may have noticed the absence of the traditional red caboose on some of today's longer trains. Instead, an end-of-train (EOT) device, radio-linked to the locomotive, provides the crew with systems status. These devices operate at 475MHz, and most of them are configured for transmission only. It's too bad they can't wave as the train disappears down the track. ■

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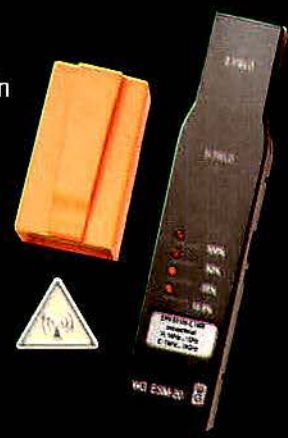

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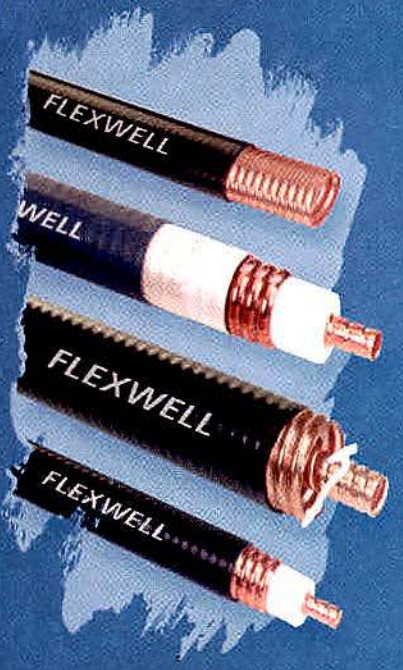

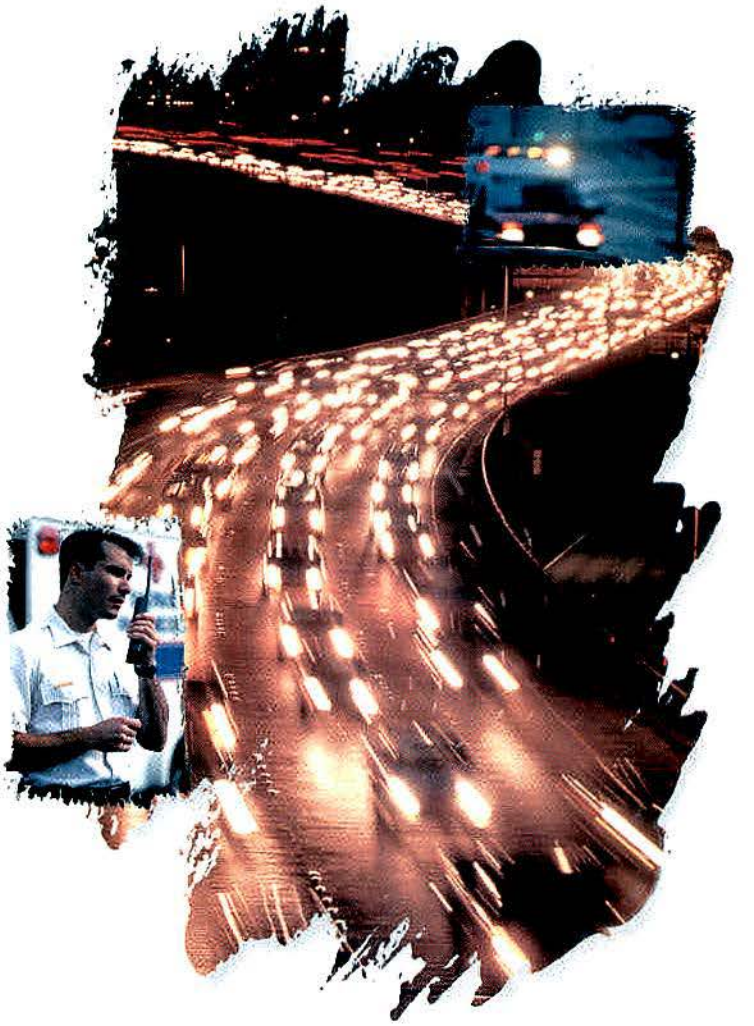

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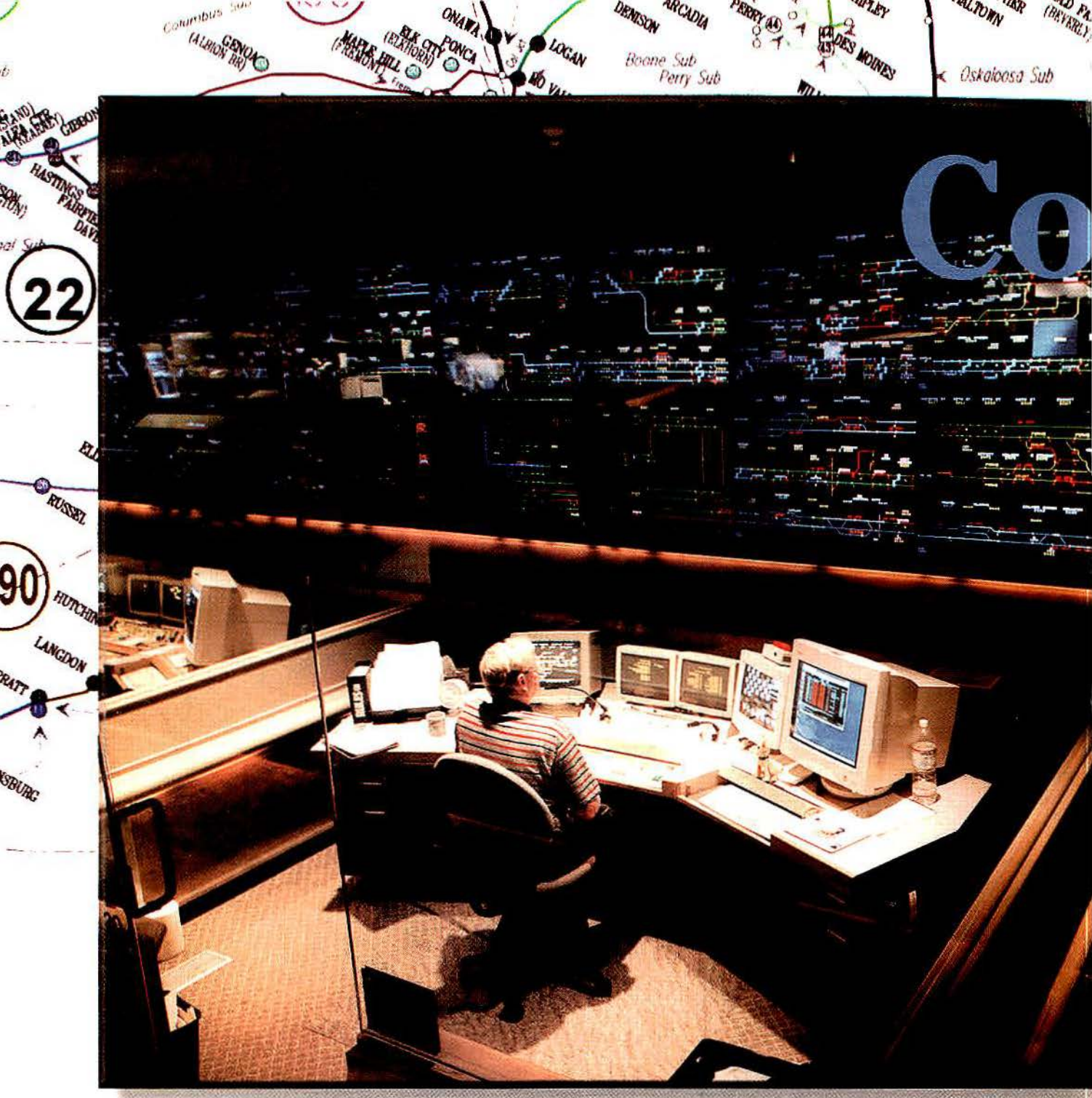


The Union Pacific Railroad's dispatch operations are managed in Omaha, NE, out of the Harriman Dispatch Center, which is considered one of the most sophisticated rail command centers of its kind in the world.

By Ramona Vassar Isbell and Larry Gibson

The daily activities of the Union Pacific (UP) Railroad, one of the largest in North America, represent a massive, well-organized operation. The rail system operates in the western two-thirds of the United States, serves 23 states and links every major West Coast and Gulf Coast port. The railroad is also the primary rail connection between the United States and Mexico, and it interchanges traffic with the Canadian rail system.

Isbell is executive editor. Gibson is a senior engineer with the Wireless Engineering Group within the Information Technologies Department of the Union Pacific Railroad, Omaha, NE.

An efficient, reliable communications system is essential to servicing more than 36,000 miles of Union Pacific track and coordinating about 52,500 railroad company employees. At any given moment, as many as 1,800 trains could be moving along the UP rail system. As for the human element, this highly mobile user group is communicating constantly via about 13,000 vehicle radios, 1,700 track fleet radios and 22,000 hand-held radios.

Maintenance on this massive fleet of radios requires precise coordination. Although initial testing is done at 13 rapid-repair centers located across the UP's coverage area, complete radio maintenance is handled at a centralized repair shop in Council Bluffs, IA.

At the heart of Union Pacific's multifaceted operation is the dispatcher radio sys-

mmunicating down the line

The dispatchers radio system functions as the heart of the Union Pacific Railroad, an enormous industrial operation that spans 23 states and more than 36,000 miles of track.

tem, the railroad's vital means of communications for the safe movement of trains, locomotives and all employees working along the tracks. Dispatcher operations are managed in Omaha, NE, out of the Harriman Dispatch Center (HDC), which is perhaps the largest and most sophisticated rail command center of its kind in the world.

Complex communication needs

Union Pacific's multitude of radio units allows the mobile workers to communicate with the dispatchers who control specific sections of track and with the yardmasters who handle the trains and locomotives within their yard. The mobile workforce also needs instant communication with the diesel shops that maintain the locomotives, the car men who maintain the cars, maintenance-of-way (MOW) forces that maintain the track, the signalmen who maintain the signal system along the tracks and any other departments involved with train movement. Interdepartmental communication is also necessary for ensuring efficient daily operations.

The dispatchers at the HDC and the yardmasters in the field must maintain constant communication with their massive mobile workforce. To do this, they rely on three console systems to access all the radios used by the different departments. An Avtec Dspatch system provides dispatchers access to the radios. A Safetran DTX system is used for yard operations—where more than five consoles are needed in any one yard. Larry

Left: The Avtec Dispatch system used by the Union Pacific provides dispatchers access to the radios being used in the field.

McGee 10-line consoles are used for employees who require access to fewer than 10 lines (radios, intercom and hotlines). All three of these console types can share access with certain radios that are needed to manage a specific yard location.

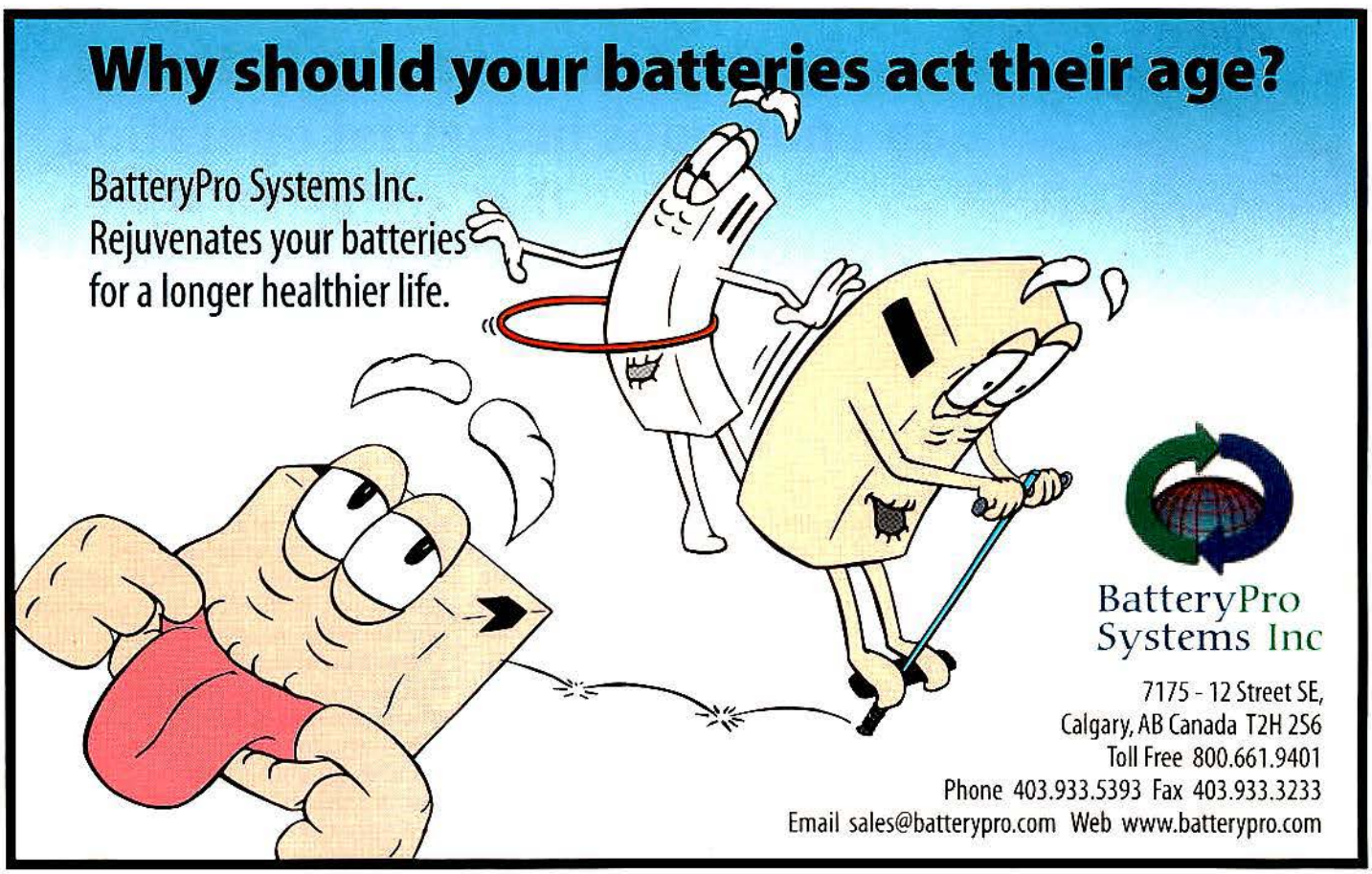
While the Safetran and Larry McGee systems generally manage communications among local radios, the Dspatch system handles the entire UP dispatcher radio network. The dispatchers rely on two radio types:

▶ *Dispatcher radios* — VHF simplex radios are spaced along the right-of-way to provide radio coverage for a specific track section. They are controlled by a dispatcher responsible for all train movement along that section. Adjacent dispatchers operate on different frequencies to avoid interference among dispatchers. Base radios on a track section usually use the same frequency. If a base radio fails, overlapping coverage provides redundancy. The use of simplex radios allows all employees using mobile and hand-held units to hear the

Facts & Figures: The Union Pacific Railroad

Miles of Track: 36,026
States Covered: 23, linking all major West Coast and Gulf Coast ports
Major Gateways Served: Chicago, St. Louis, Memphis and New Orleans
Employees: 52,523
Locomotives Owned: 6,913
Freight Cars Owned: 155,308
Mobile Radios: About 36,700
World Record: *The Guinness Book of World Records* recognized the Union Pacific's Bailey Yard in North Platte, NE, in 1995 as the world's largest railroad yard. The massive yard covers 2,850 acres, reaching a total length of eight miles. Bailey is tied to the Harriman Dispatching Center in Omaha, which controls hundreds of trains operating daily throughout the UP's system.

Source: www.uprr.com and Harriman Dispatch Center



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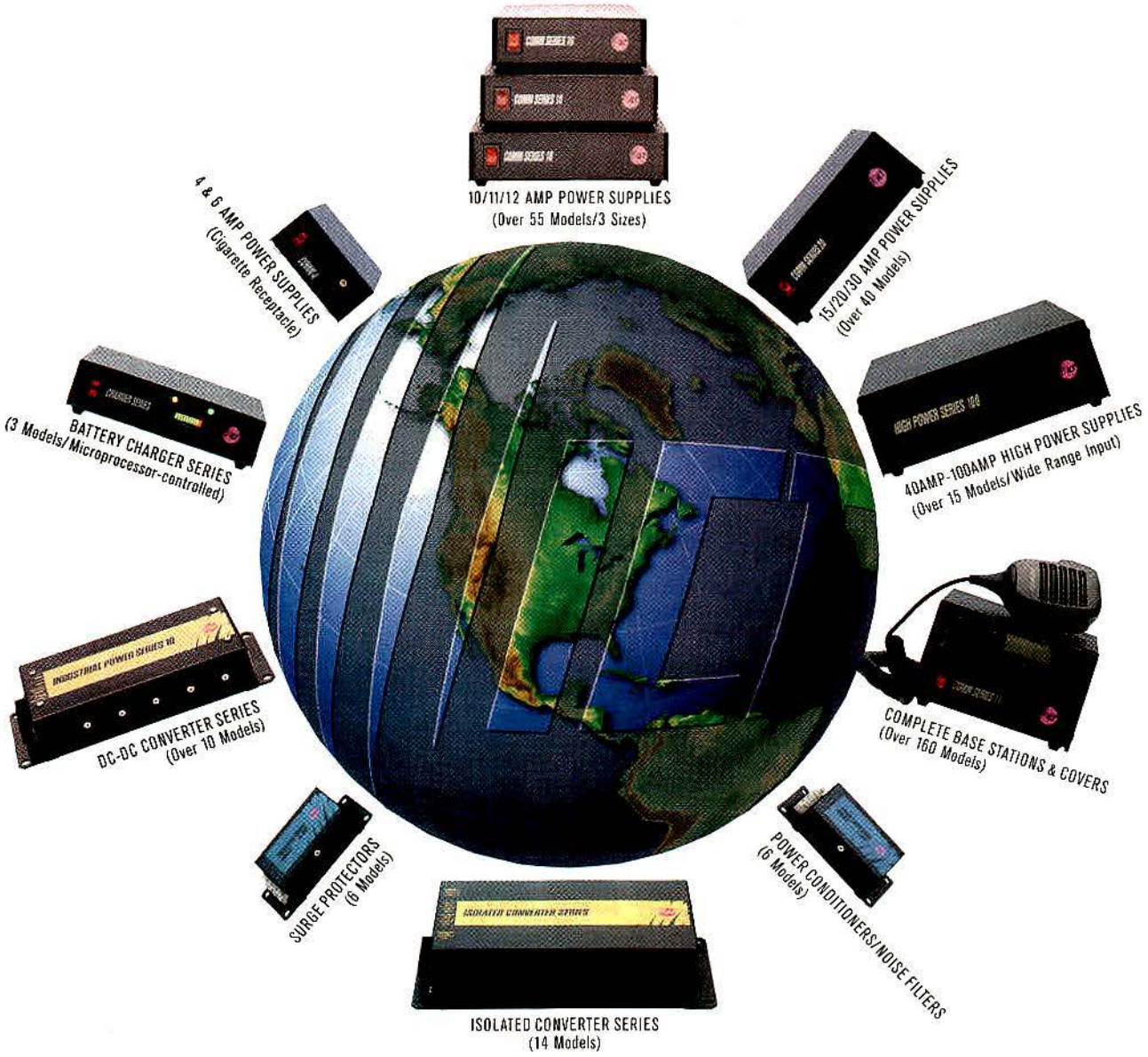

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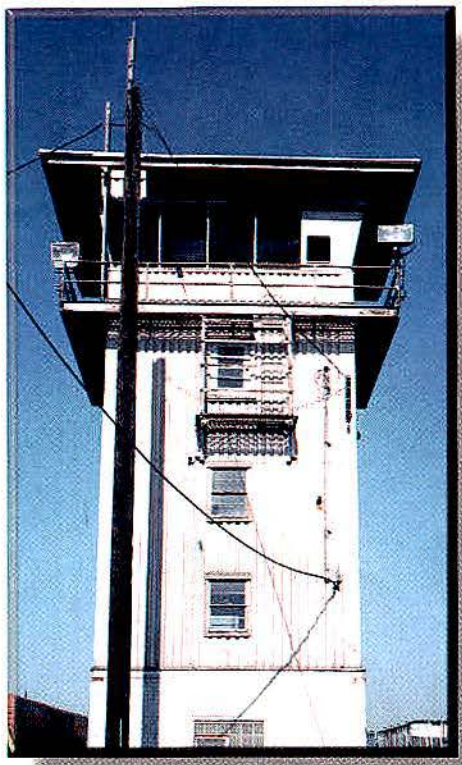
dispatcher as well as all other communications along the track.

Field personnel can make normal or emergency calls to the dispatcher by generating the appropriate three-digit DTMF code. Each dispatcher radio uses a dedicated four- or six-wire audio circuit from the radio to one of 13 system hubs. All 13 hubs are interconnected via radio tie trunks and a data circuit, which allows users to access radios from different hubs.

▶ *Mobile-tel radios* — VHF full-duplex radios are tied to Union Pacific's PBX network throughout the system to provide dial tone services to UP's mobile fleet. With this system, track forces can place phone calls and obtain track warrants from the dispatcher if the dispatcher radio system is being used. (Track warrants give the user permission to work around the track.) Each Mobile-tel radio uses a dedicated four- or six-wire audio circuit from the radio to the PBX. The radio is controlled by an MTC5000 card designed by the UP Wireless Engineering Group. This card also connects the paging system to the Mobile-tel radios to provide paging service to areas without commercial paging service. The dispatchers also can access these radios via their consoles.



Whether communicating from a yard tower, such as this one overlooking the yard in Council Bluffs, IA, or along the tracks in the yard, UP employees' main concern is that they have constant, reliable communications among the various departments.

A systematic digital evolution

UP's shift from analog to digital technology reached its final stage this summer, as it neared its scheduled completion date of July 31. This process included streamlining five analog console systems accumulated during the last 10 years of mergers into one digital system.

In 1987 the Union Pacific Railroad contracted with Avtec, Gilbert, SC, to develop an integrated radio and telecommunications system to be implemented at HDC. The following year, the railroad centralized all of the dispatchers in Omaha's center. At that time, three 240-line Avtec Access systems, one each for the western, central and southern regions, controlled about 550 radios supervised by 36 dispatchers. These Access systems were configured so that each dispatcher radio served as a four-wire extension number off the PBX network. The system would select a dedicated tie trunk to the PBX and then dial the extension number of the radio selected. The Access systems went online in 1989.

It wasn't long, however, before addressing the railroad's communications requirements became *more* complicated. Union Pacific's merger with the Chicago & North Western (C&NW) Railroad in 1995 added a 90-line Access system to the HDC to allow nine dispatchers control of 120 additional radios. The system served as a touch-screen interface to a modified Penta

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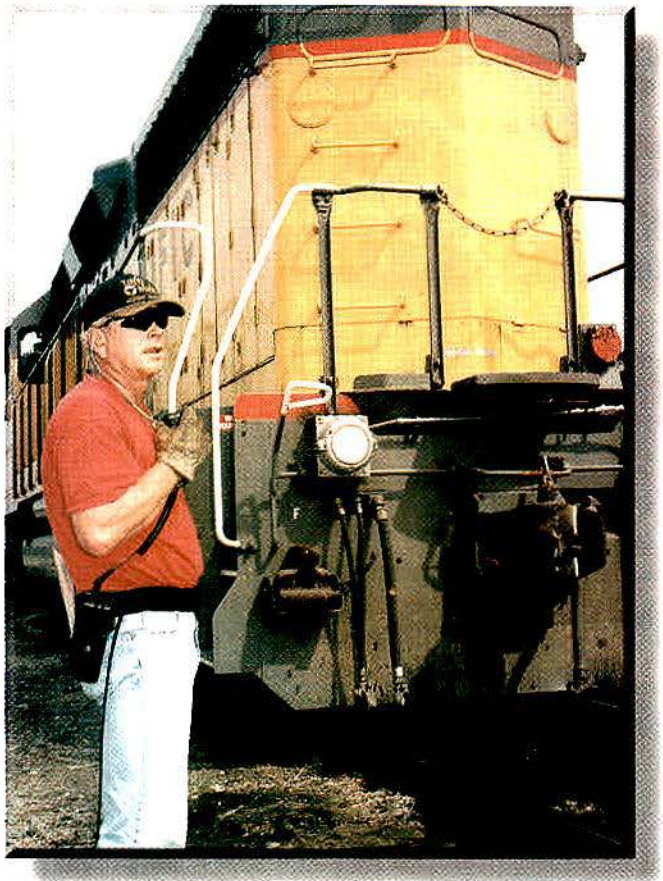
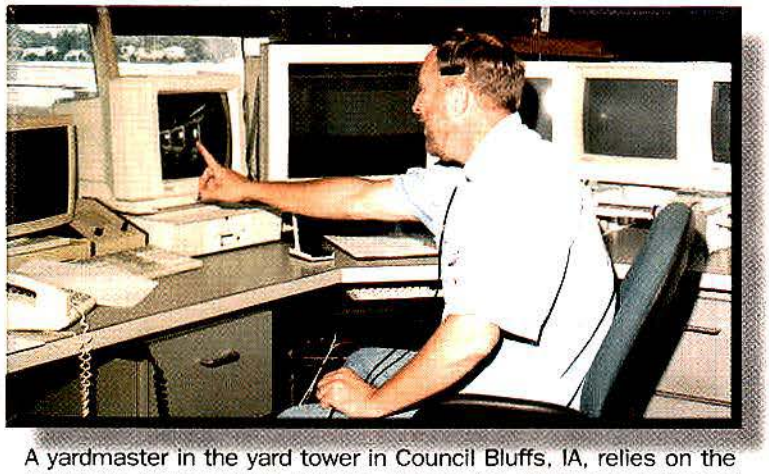


More than 52,000 employees, including this switchman, communicate constantly via about 13,000 vehicle radios, 1,700 track fleet radios and 22,000 hand-held radios.



A yardmaster in the yard tower in Council Bluffs, IA, relies on the railroad's touch-screen console system for efficient handling of the trains and locomotives within his yard.

system, which actually controlled the radios. The Avtec system would send a series of DTMF digits to one of six Penta hub switches, which in turn would route the request to the proper radio.

In 1997, UP merged with the Southern Pacific (SP) Railroad, which relied on a three-hub, early version of the Dspatch system to control about 300 dispatcher radios with 34 dispatchers. These SP hubs were in Houston, Roseville, CA, and Denver, where the SP dispatcher centers were located. The hubs were trunked together via dedicated radio tie trunks. At the time, two of the three UP systems and the 90-line C&NW system were completely full, and 34 more SP dispatchers were to move to the HDC.

With equipment space already limited at the HDC, the railroad decided to select a system that could immediately handle present needs and provide expansion options.

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Officials chose the digital Dspatch system because it would allow the UP to reuse existing SP Avtec equipment with some minor modifications. It also would allow the HDC hub system expansion capability of more than 2,000 lines. The plan called for a 2,000-line switch to be housed at the HDC, while 12 additional hub switches, connected to the HDC switch via radio tie lines, were placed throughout the network.

The current dispatch system used to control the UP radio network continues to grow daily. In addition to one 2,024-line system, the HDC includes:

- ❑ eight 19-inch cabinets (which replaced 34 existing cabinets of equipment).
- ❑ 16 T-1 interface cards for direct T-1 interface (T-1 = 24 channels per card).
- ❑ 12 remote hub locations varying from 128 to 1,024 lines.
- ❑ control of about 950 dispatcher radios.
- ❑ 236 radio tie lines to 12 remote hub locations.
- ❑ 185 workstation consoles (30 operating on PCs running Windows NT 4.0).
- ❑ 305 PBX-phone extensions (including phone extensions and hotlines).
- ❑ 18 dedicated four-wire talk circuits.

The dispatch team of 95 dispatcher positions, manned 24 hours a day, seven days a week, includes:

- ❑ 72 dispatchers at the HDC in Omaha.
- ❑ 14 dispatchers at the dispatcher center in Spring, TX.
- ❑ 4 dispatchers co-located at the office in San Bernadino, CA.
- ❑ 2 dispatchers co-located at the BNSF office in Fort Worth, TX.
- ❑ 3 terminal train dispatchers in Proviso, IL, Forth Worth, TX, and Kansas City, MO.

An interesting future

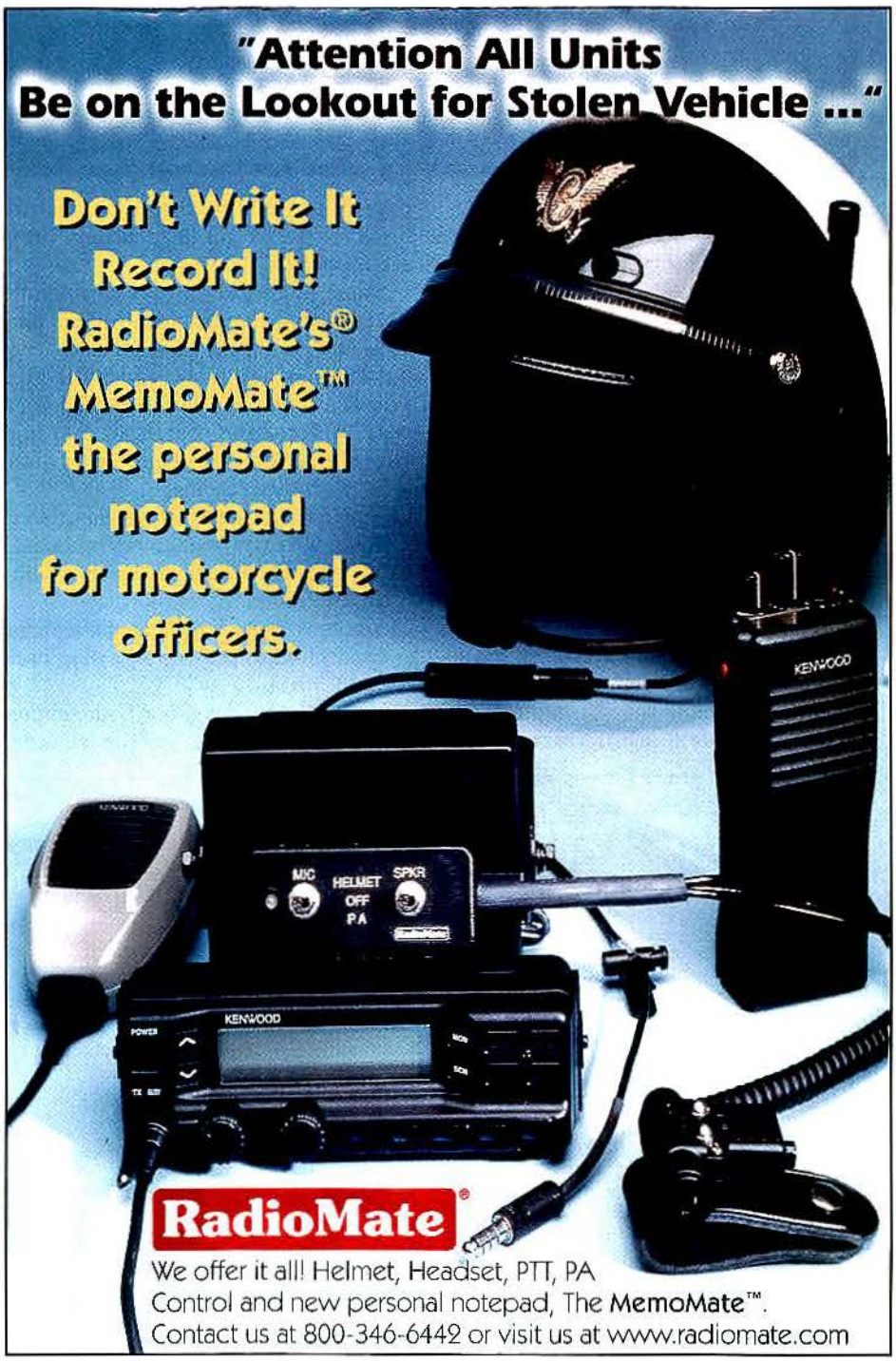
Railroad dispatch radio system technology could evolve further in the near future. As progress continues with APCO Project 25 and the impending FCC radio frequency refarming, it is a matter of time before dispatchers see benefits to their radio systems.

Project 25, APCO's suite of interoperability standards, is a project supported by railroads, as well as equipment manufacturers, public safety groups and federal government agencies. The main objective of this project is to define interface standards for a new digital radio platform. Some of the more promising features of Project 25 for dispatchers include integrated voice and data, backward compatibility with analog equipment, push-to-talk identification and voice and data encryption for secure communications.

As for radio frequency refarming, the railroad industry presently has access to 97 VHF channels (91 U.S. channels; six Canadian channels) in the range of 160.215MHz to 161.565MHz, which are 25kHz wide and spaced every 15kHz. The Association of American Railroads (AAR) performs frequency allocations and assignments. Following refarming, the industry will have 182 VHF channels, which will be 12.5kHz wide and spaced every 7.5kHz.

The 97 existing channels are primarily used for voice communications. Refarming, which will almost double the number of VHF channels, will allow better use of the frequency band, thus allowing implementation of data communications along with voice radio.

As radio systems migrate to APCO'S Project 25 standards and the FCC frequency refarming, much more information, both voice and data, can be brought into and passed out to the field. The addition of data communications will bring such benefits as GPS-derived location information (e.g. train locations, speed and direction), locomotive health, fuel level and text messaging. This information will need to interface with the radio console system to display the information to the user as needed. ■



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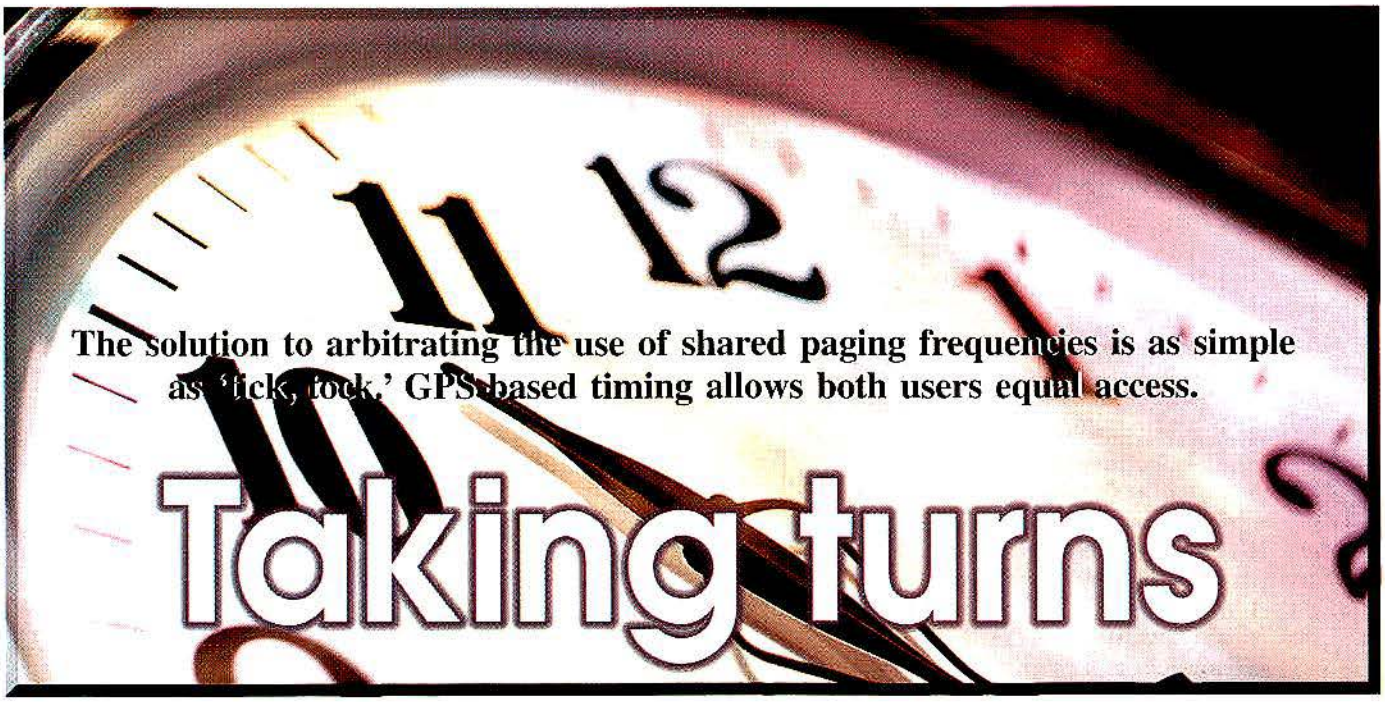

The solution to arbitrating the use of shared paging frequencies is as simple as 'tick, tock.' GPS-based timing allows both users equal access.

Taking turns

By Phil Anderson

Many paging service providers share a paging frequency (channel) in some or all locations for their systems. This is necessitated by the limited number of channels available for use on VHF, UHF and 900MHz.

The concept of time sharing a channel is simple. *You* use it for part of the time, and *your neighbor* uses it for the remaining time. You *negotiate* how much time each user will get and when. The difficulty often comes in agreeing on how to implement and coordinate equipment controls and on how much each user will pay for the costs of the arbitration hardware and installation.

Figure 1 below shows a typical scenario for system arbitration: Let the paging terminals do the job, or use "Uncle Bob's ad hoc home brew arbitrator box."

Some paging terminals can handle time sharing themselves. Simply provide an "I-want-the-channel-now" signal to your neighbor, and he'll give you the channel once he's finished with his current batch of paging. However, a number of problems often arise with this scheme:

- ❑ Your terminal and your neighbor's terminal are not the same model or brand.
- ❑ Your terminal does not have a built-in arbitration system.
- ❑ You must lease a dedicated telephone connection to provide signaling back and forth.
- ❑ You and your neighbor both support area-wide traffic, so the channel might be held for long periods by one of the systems, locking the other system out.

Not all paging terminals are alike. Typically, they don't use the same logic in deciding when to request or to relinquish a channel, making it hard for you to configure the terminals to share a channel. Some terminals keep the channel unless you request it, so you might be placed in a dependent position. Some terminals support request-to-send/clear- to-send (RTS-CTS) channel sharing, and some do not. With RTS-CTS, a terminal requests the channel when it has paging, and the other system returns that request with a "CTS," meaning "go ahead." If both systems

Anderson is an executive with Kantronics, Lawrence, KS.

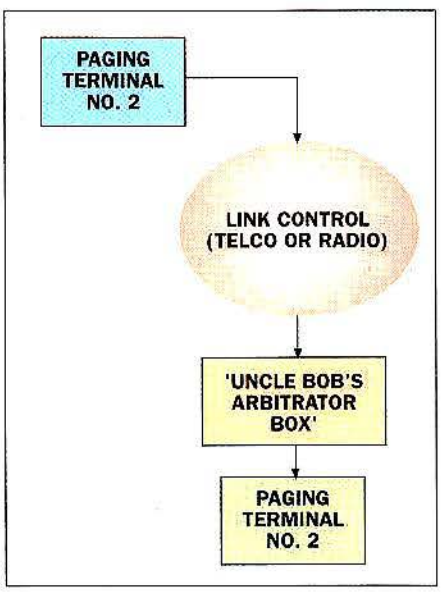

Figure 1. Typical arbitration of paging use.

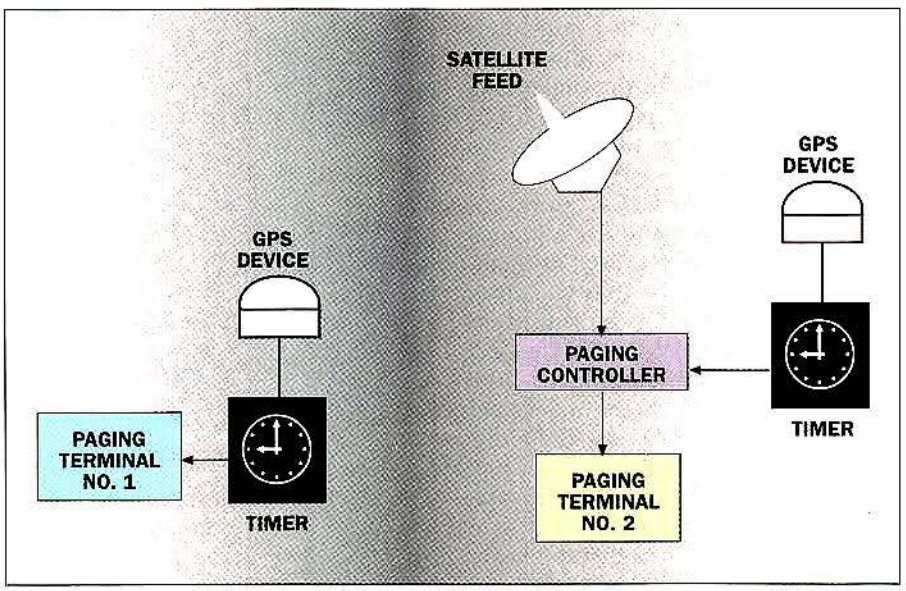

Figure 2. Simplified terminal arbitration using GPS timing.

support RTS-CTS, and you are willing to spend money to support a four-wire (two-circuit) line between them, then you can share the channel. However, you still must deal with the situation when one channel has a lot of traffic, and holds the other one off too long. True, some systems will limit their transmit times, allowing the other system to go.

So what about Uncle Bob's arbitrator box? Let's face it; there are probably as many invented arbitration schemes as there are private carrier paging systems. If your neighbor has one of these home-brew boxes, you'll have to be content with whatever logic Uncle Bob dreamed up. It's guaranteed that it will not be standard, but it will work for Bob.

A simple remedy to this is shown in Figure 2 on page 40. Simply place a Global Positioning System (GPS) timer at each paging terminal, and let each timer tell its system it may or may not have the paging channel. The timers will be coordinated because they both capture their time from the same satellites—the GPS system.

A GPS timer consists of a GPS antenna, a GPS module and a small microcomputer system, i.e., the timer. The timer captures the time from the GPS module and provides a "you-have-the-channel-now" output signal to the paging terminal. The timers will have to be coordinated, which can be achieved by agreeing on separate times for each system and programming those durations into the timer, using a terminal program such as PRO-COMM.

For example, let's say that you wish to transmit on the first 28 seconds of every minute, and your neighbor has agreed to transmit on the second half of each minute for 28 seconds. Here's how you set the timers:

Program yours for the first 28 seconds of each minute: TIMEOUT EVERY 60 START 00 PULSE 28.

Your neighbor's timer would be programmed this way: TIMEOUT EVERY 60 START 30 PULSE 28.

EVERY sets the cycle (full duration) of each timer; START sets the starting time, and PULSE sets the CTS signal duration, all in seconds.

Your paging system *and* your neighbor's system are now disconnected from each other. They each know when they have the channel, based on coordinated universal time (UTC) and the CTS signal from the GPS-based timer. Uncle Bob's arbitrator box may take a position on the museum shelf, and you can disconnect and cancel that leased telco line. ■

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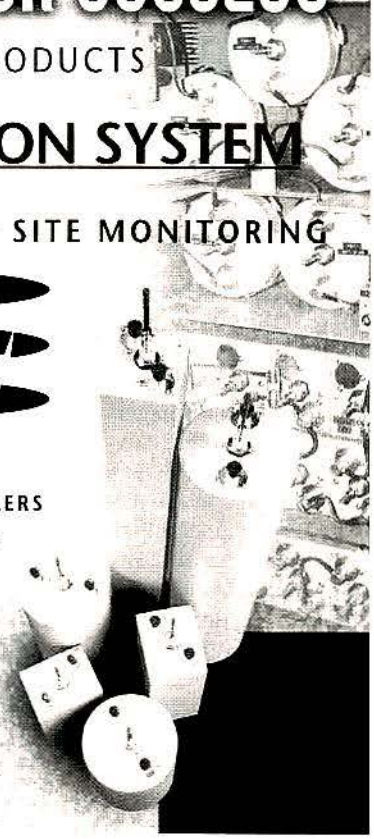

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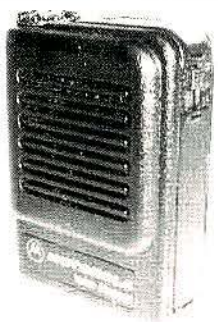

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The changing face of paging

From a simple alert to two-way communications, the little beeper has become the personal assistant.

By M. Major

From its humble beginnings in the hospitals of the 1950s, the pager made great strides to become the device popularized by business professionals in the late 1980s. Originally, pagers were simple radio receivers designed to deliver a radio message selectively to a particular individual.

As years passed and information transfer became more important, however, pagers were forced to evolve. Until the 1990s, pagers did little more than alert the user of a message and provide a phone number at which to reach the sender. In true Darwinian fashion, the modern pager continues to evolve and to offer new capabilities.

In a world where high-tech complexity runs rampant, it's easy to assume the pager, at least, has remained simple. Not anymore. In fact, paging has become so multifaceted that even pager manufacturers have trouble keeping up with the changes.

Dayakar Puskoor, CEO of Dallas-based JP Systems, said that just two years ago he attempted to convince the industry to incorporate pagers into personal digital assistants (PDAs). Nobody was interested, so Puskoor started working on the project himself. This spring, he reported "everybody is forming an alliance to put two-way paging into PDAs." Puskoor added that he was "happy the industry is going in this direction," although it's likely that he would prefer that it doesn't move fast enough to catch up with him.

The differentiator of this new pager generation is the capability to *respond* to an incoming message. Now, Puskoor said, you can communicate back directly, through virtually any medium.

This might imply the demise of the stand-alone pager. To a large extent, this is true. Adam Winters, former marketing manager for distributor Marketronics, Sunrise, FL, said that during the past two years sales of the stand-alone pager had deteriorated.

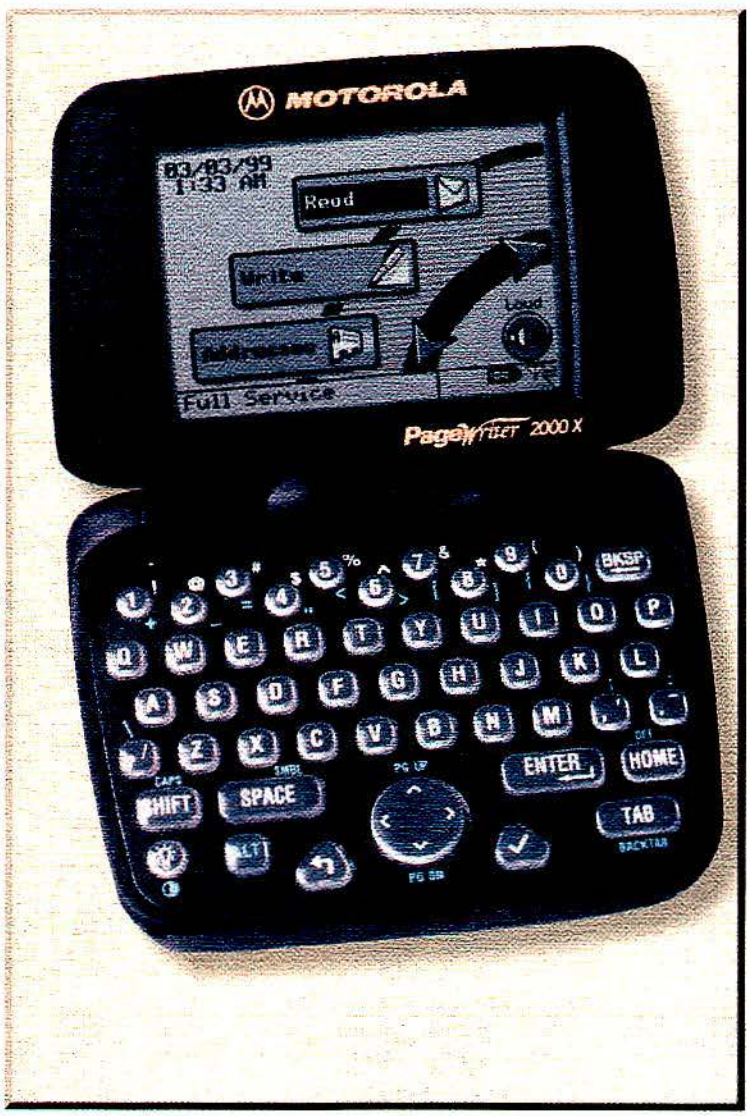
"I expect this pace will quicken over the next couple of years," Winters said.

With the advent of two-way advanced messaging, which offers many overlapping features, it's hard to keep track of available technologies. Lee Ellison, senior vice president of sales and marketing for Glenayre Technologies, Charlotte, NC, noted that in addition to person-to-person communications, there is device-to-device telemetry.

These devices, which are used for management purposes, include functions such as monitoring networks, meter reading or vending machine polling. Polling devices contact a machine that provides a reflex response detailing the number of products yet to be sold. The route driver then can be alerted not to make unnecessary stops.

Although the big news is the incorporation of paging into all kinds of PDAs, there's also the alternative of adding more features to traditional pagers. For instance, Bailey Zheng, president, Linktronic Systems, Los Alamitos, CA, said that he was taking his traditional paging devices in three directions. One path is to use the paging infrastructure to send email. Another path is to connect to the Internet. The third path is to move into the sender market by incorporating cellular technology.

Glenayre's Ellison calls these



The future of pagers is starting to look more like the Motorola Pagewriter shown here than the simple alert messengers of 40 years ago.

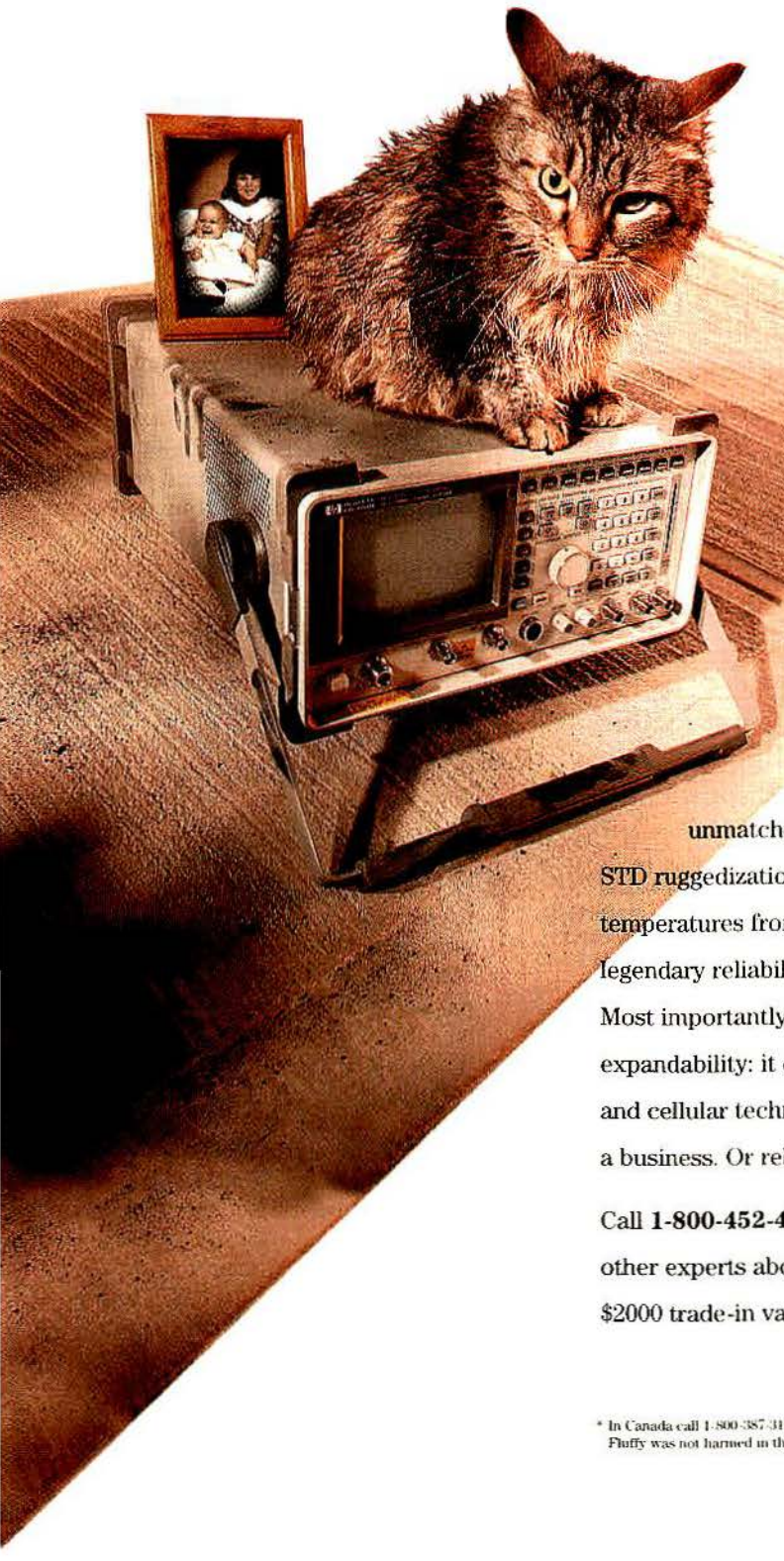
Major is a communications writer in the state of Washington.

October 2, 1996.

Bob Jensen had
a fire at his mobile
radio repair shop.

He had only a
few seconds to
save things.

Thanks for the vote of
confidence, Bob.



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traditional pagers "belt-tops." They have the same lightweight size as standard pagers, with the same extensive battery life. But they can also originate messages and send queries.

"The advantages of the belt-top devices is that they can be always with you and always turned on, whereas a palmtop may be in a briefcase or turned off to save the batteries," Ellison said.

That opens the door for the proliferating PDA category, including: smart phones, such as the Mitsubishi Mobile and the Samsung Duette; palmtops, such as the 3Com Palmpilot Pro/3 with Novatel Wireless Minstrel model; and Windows CE hand-held PCs.

Companies are offering variations of wireless connections for PDAs. For example, JP Systems' Puskoor said that wireless links allow the user to send email from a PDA or to connect to the Web for yellow pages and to retrieve the desired information.

San Diego-based Novatel Wireless offers modems to provide two-way access to corporate data, email and the Internet without the need for phone lines or a wired connection, said marketing manager Mona Thomas. Each modem has its own IP address and connects to the Internet via the Wireless IP network. Wireless IP, also known as cellular digital packet data (CDPD), is a method of transmitting data in small packets of information over the existing cellular network.

Practical Sales Tools (PST), Blue Bell, PA, claims to have offered the first fully interactive wireless data interface between popular contact-management programs and portable devices, such as the 3Com Palmpilot, with its Novatel Wireless Minstrel modem.

PST's president, Ed Dempsey, said, "Critical junctures in a sales or customer-service pipeline can happen in airports, lobbies, cars and other venues—places where mobile professionals cannot conveniently use their laptops or obtain an Internet connection and access current data." Dempsey added that his product literally puts corporate databases and contact managers in the palms of field representatives' hands using wireless connectivity. Field personnel not only view the data, but also input their own, thus updating the data and providing real-time access for everyone in the company.

"This can dramatically improve the success of current or planned sales automation implementations while empowering mobile professionals with convenient, complete and current customer and prospect data, anytime, anywhere," Dempsey said.

This system does not require data synchronization, so the master copy of the database reflects all of the changes made by all users in real time. When users initiate access, the information is current from the time the connection is made, which enables users to make better informed decisions.

"Because this is a true thin-client solution, it does not require any software installations on the hand-held devices," Dempsey said.

Datalink.net, San Jose, CA, is offering a new service that allows companies to extend their Web presence to wireless devices. Anthony LaPine, Datalink's CEO, said, "Wireless-enabled Web sites will allow companies to free their Internet content from the desktop and reach their audiences no matter where they are through wireless." Datalink.net's patented technology enables the filtration and extraction of information from a Web page, then formats that information for wireless devices and delivers it to the end users' pager, phone or PDA.

"Wireless-enabled Web technology has enormous possibilities," LaPine

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Circle (38) on Fast Fact Card

said. "Any Web site will be able to expand its reach, no matter where its customers are. It will be able to send out important information and carry out e-commerce beyond the traditional confines of the computer, opening up whole new markets for the Internet."

Glenayre's Ellison said that these improvements in communications technology, in general, and paging, in particular, are being driven "by people willing to pay for perceived value."

"The value of a message telling you to return a call has some limited value," he said. "But there is a drive for increased efficiency and better communication with higher-quality information. As people become more mobile, they are looking for solutions rather than features."

Applications are proliferating. "You can track the status of Federal Express shipments," Ellison said. "You can query updates from stock quotations, with automated directions to sell at a certain price. You can track airline flights, so that if there is a delay, you can know how long to wait before you have to go to the airport. You have the ability to enter text messaging and have it delivered, via speech, to anybody with a telephone."

Ellison added that peer-to-peer communications are easy and analogous to the chat service on the Internet. If you're sitting at an airport with one of these wireless devices, you can communicate comfortably with your assistant or with other staff members through their email.

In other words, the term "beeper" is no longer applicable. Although simple alert and numeric-only pagers may go the way of the dodo, a new generation of pager, offering email and Internet access, has evolved to take its place in the information food chain. ■

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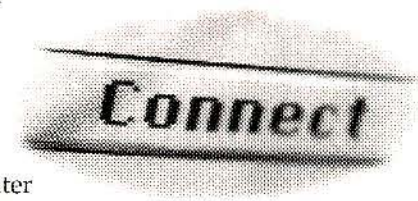

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Circle (39) on Fast Fact Card

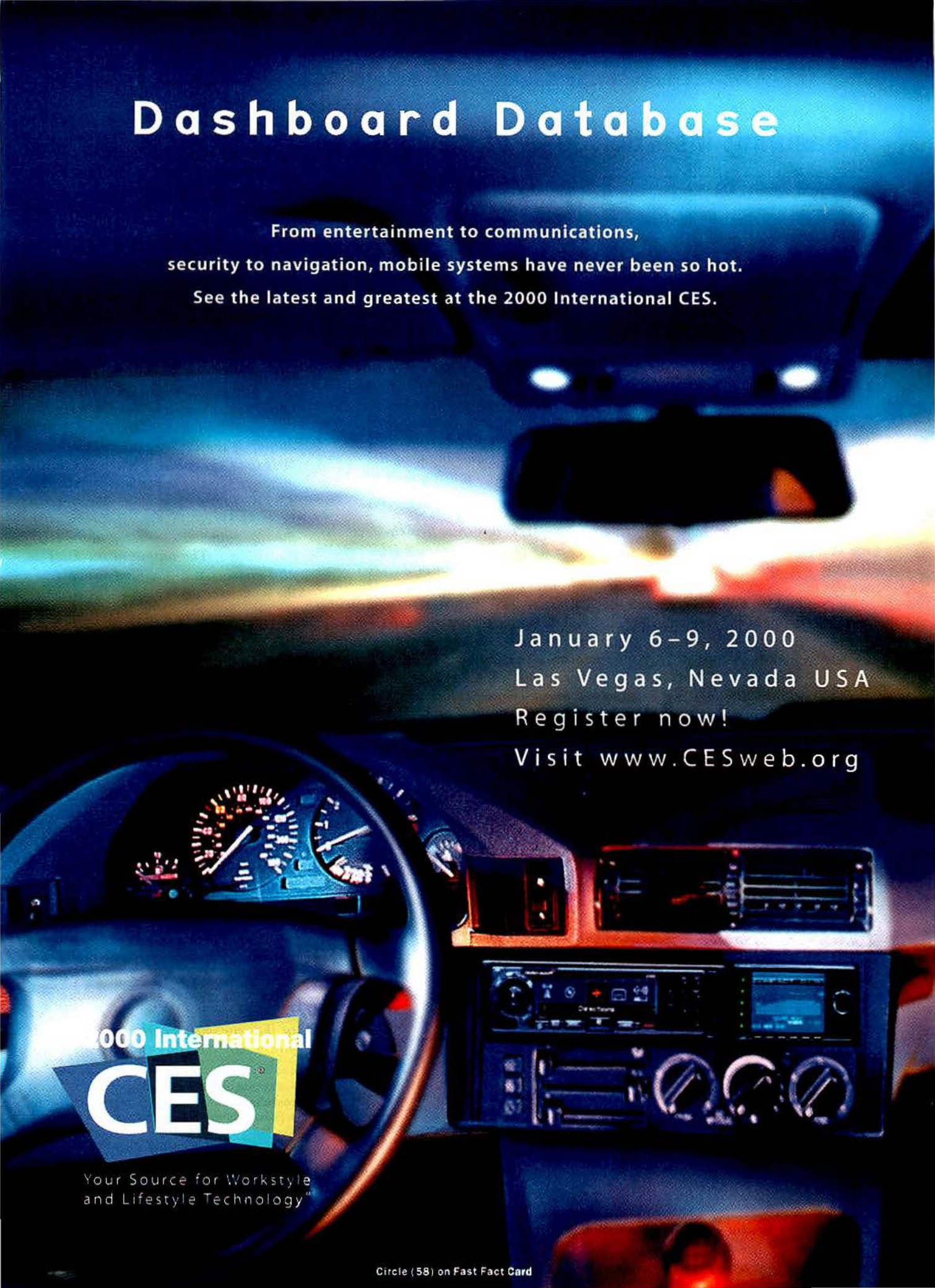
Wireless data is coming sooner than you think

Several paging and mobile phone manufacturers are developing devices that will do everything from agenda organizing to Web surfing. Handsets will have built-in screens, allowing email and Internet access through digital phone service. The debate continues about whether all of these services should be incorporated into a phone or whether they should be put into a separate device, enabling users to talk on the phone while checking email or stock quotes.

This new era of mobile communications has pitted Symbian against Microsoft over whose operating system will become dominant among these new mobile super-devices. Symbian has developed the EPOC operating system to rival Microsoft's Windows CE. Nokia has already made a firm commitment to Symbian and EPOC through its joint venture.

Nokia, Sprint PCS and BellSouth, among many others, are involved in developing plans for these new devices. Many believe that 2000, when numerous applications will become available, will be a big year for wireless data.

These new mobile devices (whether incorporated into phones or not) will have bandwidth and screen-size limitations. Some of the advanced graphics, color and animation incorporated into many Web sites will have to be stripped away, leaving only the "bare-bones" information for these devices to deliver. Many users may perceive that as a positive alteration rather than as a drawback, however.



Circle (58) on Fast Fact Card

Measuring insertion loss of cavities

By Harold Kinley, C.E.T.

How much insertion loss is your cavity causing at the *desired* or *pass* frequency? How does a field technician measure the insertion loss without access to laboratory-type equipment or under field-test conditions? It can be done with reasonable accuracy using some basic methods.

Recently, while surfing the Internet, I came across an interesting application note in the form of a "Tech-aid" called "Measuring Insertion Loss with Wattmeters" from TX RX Systems, Angola, NY. You can find it at www.txrx.com/f3c.html. With permission from TX RX Systems, the document from the Web site is presented here, with minor editing for space considerations. Following the note, I offer some of my thoughts. (On the Web site, Figure 1 and Figure 2 are the same, which is an obvious oversight. So, I added Figure 1 to match the text description of the test setup.)

Measuring Insertion Loss with Wattmeters

Passband insertion loss is a primary specification of a wide variety of passive RF devices. Typical insertion loss values are relatively small and therefore are difficult to measure with anything but laboratory-quality instruments. At TX RX Systems, we measure insertion loss using the latest Hewlett-Packard network analyzers. The calibration of our instruments is traceable to the National Institute of Standards and Technology (NIST) ...

It is not easy to accurately measure low values of insertion loss at high power using ordinary radio transmitters as signal sources and RF wattmeters, such as the Bird model 43 or similar. In fact, insertion loss under power cannot be measured directly; it must be calculated as a ratio of measured RF power at the output and input of the device under test (DUT), using the formula:

$$IL = 10 \times \log (P_o \div P_i)$$

where IL is insertion loss (in decibels), Pi is RF power input at the DUT and Po is RF power at output of the DUT.

This Tech-aid explains why indirect insertion loss measurements made with a single wattmeter are prone to significant errors and describes a two-wattmeter method that is more likely to be in agreement with measurements made with laboratory-quality instruments.

Single-wattmeter method

In general, it is not possible to use a single wattmeter to measure device input and output power with sufficient accuracy to verify factory insertion-loss specifications. There are just too many possible sources of error.

Figures 1A and 1B describe a common method of performing the required power measurements. The DUT has a factory-measured insertion loss of −1.5dB at the pass frequency. The wattmeter is a Bird model 43 with a 50W element, and the transmitter is a 30W mobile transceiver. Random-length coaxial cables are used for equipment connections.

In Figure 1A (below left), the transmitter is connected to the DUT via the wattmeter and test cables 1 and 2. The output of the device is connected to a 50Ω load via cable 3. When the transmitter is keyed, the wattmeter indicates 32.3W forward power. We record Pi = 32.3W. In Figure 1B (below left), the transmitter is connected to the DUT via cable 1. The output of the DUT is now connected to the load via cable 3, the wattmeter and cable 2. The wattmeter now indicates 20W forward power. We record Po = 20.0W.

With the above power measurements, insertion loss is calculated as follows:

$$IL = 10 \times \log (20 \div 32.3)$$
$$= 10 \times (-0.21)$$
$$= -2.1\text{dB}$$

Is this filter out of specification? Before we reach any conclusions, let us take a close look at the possible sources of error inherent to the single-wattmeter method.

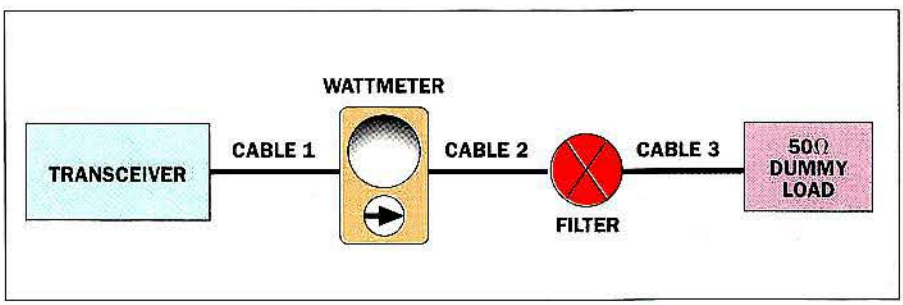


Figure 1A. The wattmeter is positioned on the input side of the filter and the forward power is measured. Random lengths of cable are used.

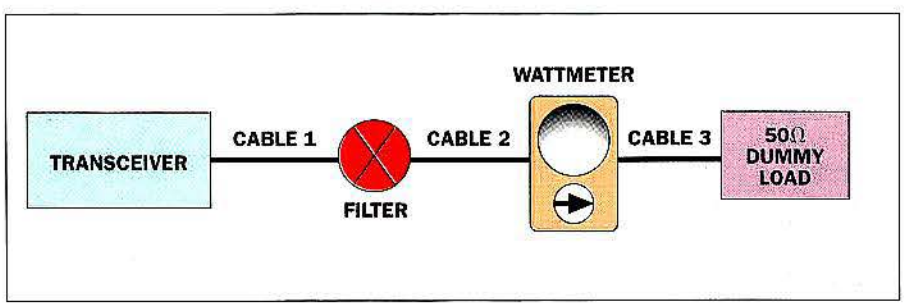


Figure 1B. The forward power on the output side of the filter is measured in this setup.

Sources of measurement error

▶ Transmitter load impedance changes — *Substantially different lengths of cable are used to connect the DUT to the transmitter in 1A and 1B. If filter input impedance is not purely resistive and equal to 50Ω, changing the length of cable between it and the transmitter can change the magnitude and phase of the load impedance presented to the transmitter. Transmitter output power may therefore change, due to the*

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Kinley's email address is hkinley@home.com.

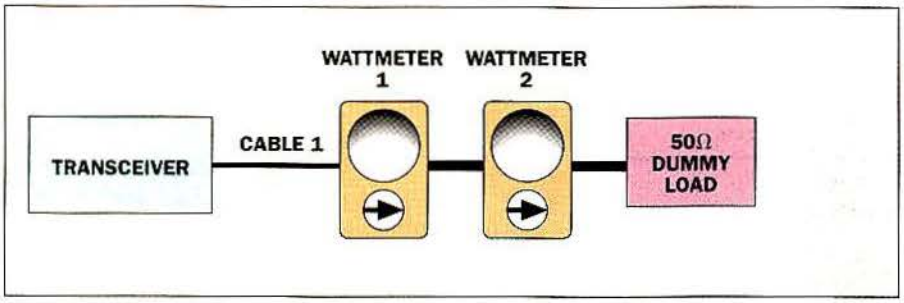

Figure 2A. This setup is used to establish the calibration of the wattmeters and to determine a correction factor.

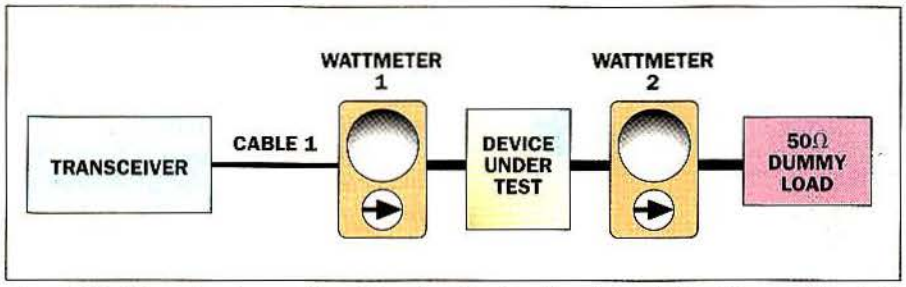

Figure 2B. This setup is used to determine the insertion loss of the filter or other DUT (device under test).

load impedance changes caused by moving the wattmeter and one cable from the input to the output of the DUT.

▶ Wattmeter position — *Standing waves exist in a transmission line that is terminated in a mismatched or reactive load. Depending on the VSWR, different power measurements may be obtained with the wattmeter at different points within the standing wave pattern in the test cables.*

▶ Cable and fitting insertion loss — *The loss of all interconnecting cables and fittings that affect power measurements must be considered in the calculation of insertion loss. The total error ... could easily be about 0.6dB, the discrepancy between factory specification and field measurement ... worse if the test transmitter were unstable.*

▶ Transmitter instability — *Some transmitter power amplifiers may not be stable at all load impedances and phase angles. Resonant devices in particular may exhibit large reactive components at off-resonance frequencies. This may induce parametric oscillations that produce significant output power at frequencies outside the passband of the DUT. If the transmitter is oscillating, a wattmeter measurement of transmitter output power will include spurious power. If spurious power is significantly attenuated by the filter under test, a "false insertion loss" will result. Depending on the ratio of spurious to carrier power, and the response of the DUT, even larger insertion loss measurement errors may be induced.*

In Figure 1C [not shown], the transmitter oscillates when it is connected to the DUT via a shorter, unfavorable length of cable. The wattmeter on the filter output reads only 15.5W forward power, because about 4.5W of spurious power are not passing through the cavity

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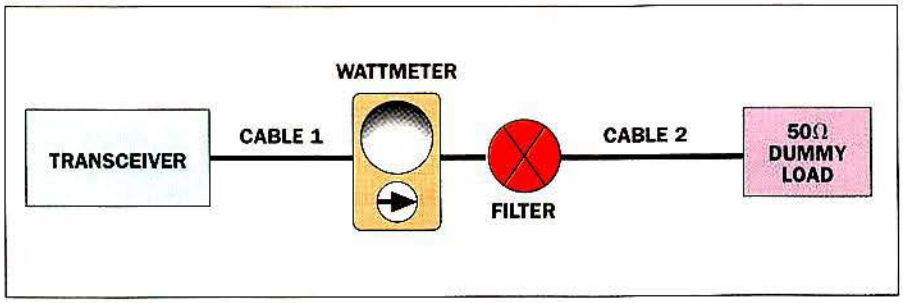


Figure 3A: This single-wattmeter method of measuring insertion loss is valid as long as proper attention is paid to cable lengths. The input power to the filter is measured here.

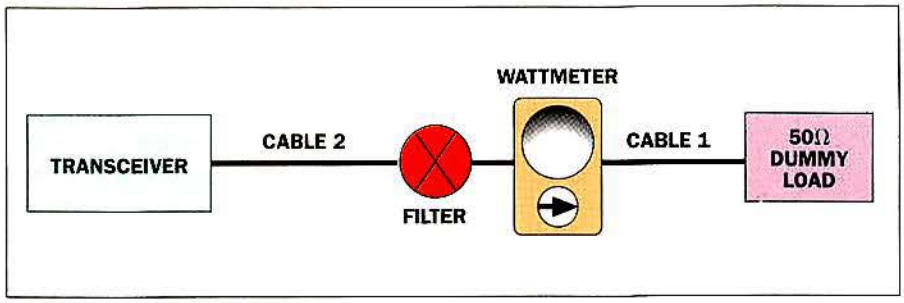


Figure 3B: The output power from the filter is measured here. Cable lengths of one-half wavelengths (or multiples) are maintained in this procedure.

filter. Insertion loss now appears to be:

$$\begin{aligned} IL &= 10 \times \log (15.5 \div 32.5) \\ &= 10 \times (-0.32) \\ &= -3.2\text{dB}. \end{aligned}$$

This result is completely wrong.

Recommended test method

TX RX Systems recommends a two-wattmeter, two-step method that eliminates most of these problems. The arrangement in Figure 2A (see page 49) is first used to obtain wattmeter readings to correct for test equipment insertion loss and wattmeter relative calibration errors. The setup in Figure 2B (see page 49) is then used to measure input and output power.

Cable 1 is cut to a length such that total transmission line length from transmitter output to the wattmeter output is a multiple of a ½-wavelength (λ/2) at the test frequency. This ensures that the load impedance "seen" by the transmitter is essentially the same as the impedance of the DUT connected to wattmeter 1. Wattmeter operating manuals usually contain information on optimal lengths of cable required for various frequency ranges.

In Figure 2B, wattmeters 1 and 2 are connected directly to the input and output of the DUT, using a short cable or a type N male-to-male union (UG-57B/U, TX RX part no. 8-5857). It may also be necessary to use a type N, 90° male-to-female adapter (UG-27C/U, TX RX part no. 8-5867) to facilitate installation of the wattmeters near the DUT. In Figure 2A, the wattmeters are connected using the same fittings as in Figure 2B, plus an additional type N female-to-female union (UG-29B/U, TX RX part no.8-5856).

The 50Ω load resistor in Figures 1 and 2 should be connected to the output of wattmeter 2 via a short length of coaxial cable or a type N male-to-male union. The length of transmission line between the wattmeter and the load resistor is not critical if return loss is −30dB or better.

Test procedure

1. *Connect wattmeter 1 directly to wattmeter 2 as shown in Figure 2A. Key the transmitter and record the forward power readings, P1 and P2.*
2. *Unkey the transmitter and insert the DUT between wattmeters 1 and 2, as shown in Figure 2B.*
3. *Key the transmitter again and record the forward power readings, P3 and P4.*
4. *Calculate insertion loss as follows:*

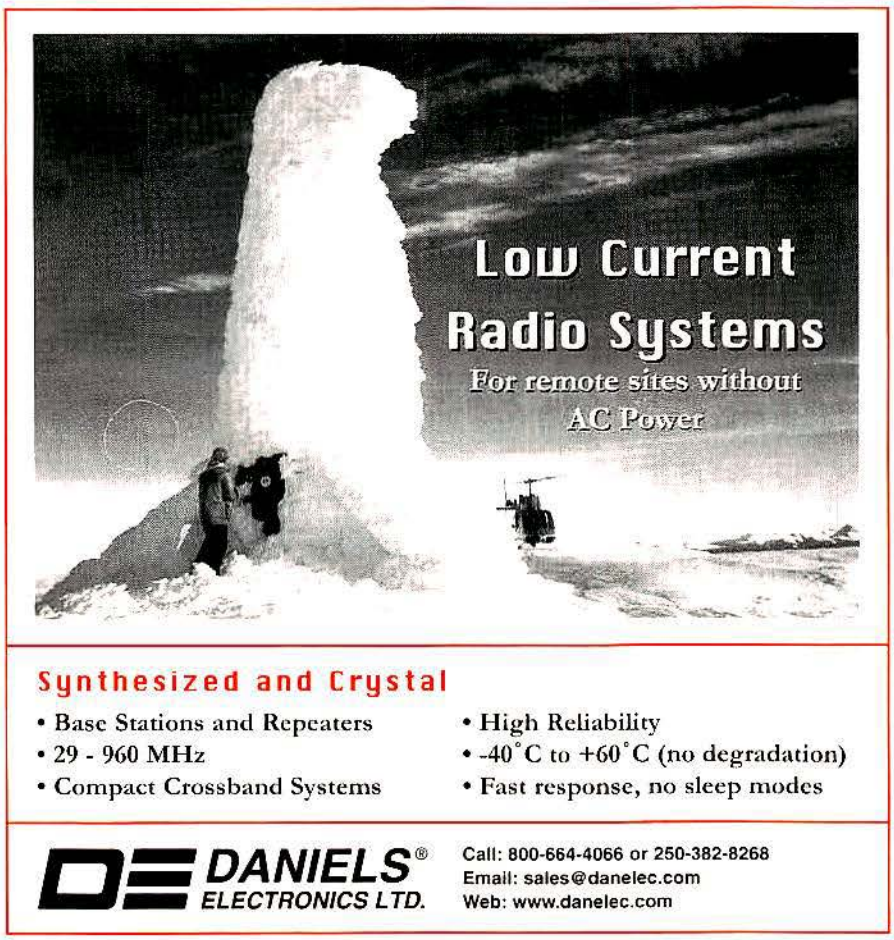
$$IL = 10 \log ((P1 \times P4) \div (P2 \times P3)).$$

The following measurements are obtained with the cavity filter in the previous example: P1 = 28.7W; P3 = 28.0W; P2 = 24.0W; and P4 = 16.8W.

Computed insertion loss is:

$$\begin{aligned} Po \div Pi &= (28.7 \times 16.8) \div (24.0 \times 28.0) \\ &= 0.7175 \\ IL &= 10 \log (0.7175) \\ &= -1.44\text{dB} \end{aligned}$$

This is within less than 0.1dB of the factory specification for the filter under test.



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In case of a discrepancy, if you use the suggested two-wattmeter method and your insertion loss measurement does not agree with ours, there are two likely causes: Either your transmitter is oscillating, or our equipment is indeed out of specification.

With the equipment arranged as in Figure 2B, insert a −30dB RF sampler on the transmitter output and check the transmitter spectral purity with a spectrum analyzer. Carefully scan a broad frequency range, as spurious outputs may sometimes appear at frequencies far removed from the carrier. If the transmitter is clean, it is safe to conclude that the equipment is out of specification. You should then file a warranty claim.

Other precautions

1. *Use wattmeter elements that produce a wattmeter reading at mid-scale or higher.*
2. *Use the best cable and connectors money can buy. If possible, connectors should be crimped and soldered. A bad connector will ruin your measurement.*
3. *Do* not *use UHF connectors or adapters. UHF connectors are notorious for their bad impedance characteristics even at VHF frequencies. Put type N connectors on your wattmeter.*
4. *Check the spectral purity of your test transmitter. All spurious products and harmonics must be at least 60dB to 70dB below the carrier when the transmitter is loaded as in Figure 2B.*

Brief observations

The points made by this application note are well worth remembering and following. I would like to comment on a couple of points. Concerning the wattmeter position along the line, the note stated that *"Depending upon the VSWR, different power measurements may be obtained with the wattmeter at different points within the standing wave pattern in the test cables."* Specific mention was made of the Bird model 43 wattmeter. The Bird 43 instruction book, page 2-0, states *"Being highly directional, the Thruline Element is sensitive at one setting only to one of the traveling waves, which produce standing waves by interference. Thruline measurements are therefore independent of position along standing waves. It may be said that the Thruline doesn't know, doesn't care and doesn't need to care where it is along a standing wave."*

Because any spurious signal would affect the single-wattmeter method of measuring insertion loss, it would also affect the two-wattmeter method. The two-wattmeter method gives no advantage in this regard.

Single-wattmeter method

I am not arguing against the two-wattmeter method of performing the insertion loss test. However, if only one wattmeter is available, there is a way to use a single wattmeter to measure the insertion loss of a filter with a reasonable degree of accuracy. Refer to Figures 3A and 3B on page 50.

In Figure 3A (assuming N connectors throughout), the wattmeter is connected to the filter input directly using an N male-to-male connector. The length of cable 1 is chosen such that:

cable 1 + wattmeter through-line section + N male-to-male connector

is equal to λ/2 (or a multiple thereof) at the operating frequency. The type N male-to-male connector is used to connect the wattmeter directly to the filter in both Figures 3A and 3B. The velocity factor of the cable must be taken into account when calculating the cable length. Assuming that all the lines between the transmitter output and the filter input total λ/2, or a multiple thereof, the input impedance of the filter will be seen by the transmitter output.

Cable 2, connecting the filter output to the dummy load, is also cut to λ/2 (or a multiple).

With the setup in Figure 3A, the transmitter is keyed and the forward power reading is recorded. Record this measurement as P_i. Also take a look at the reverse power reading to check for a severe impedance mismatch. Now, using the setup shown in Figure 3B, key the transmitter and record the wattmeter reading as P_o. Notice that in Figure 3B, cable 2 connects the transmitter to the filter input. The line length is still λ/2, so the impedance seen by the transmitter has not changed.

Using the readings, you can determine the insertion loss by the formula:

$$IL = 10 \log (Pi \div Po).$$

If Pi = 40W and Po = 30W, then the insertion loss of the filter is:

$$10 \log (40 \div 30) = 10 \log (1.333) = 1.25\text{dB}.$$

All precautions stated for the two-wattmeter method apply to the one-wattmeter method as well. Reasonable care in setting up the test procedure will yield reasonable accuracy in the result.

Until next time—*stay tuned!* ■

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Securicor raises offer for Intek Global buyout

Securicor, the majority owner of Intek Global, New York, has settled pending class action lawsuits connected with its tender offer to buy the rest of Intek's stock. UK-based Securicor already owns about 62% of Intek. Its purchase of Intek shares would end Intek's status as a public U.S. company, converting it into a Securicor subsidiary.

Standing in the way of the completion of Securicor's earlier $2.75/share tender offer were three class action lawsuits. The plaintiffs agreed to drop their lawsuits, and Securicor agreed to raise its offer to $3.0125/share. Two depositions regarding the lawsuits were taken on July 7 and 8, including the testimony of a senior representative of Lazard Freres & Company, Securicor's financial advisor in connection with the tender offer.

The plaintiffs declined to exercise their right to withdraw from the settlement within 96 hours following the completion of the depositions. Accordingly, a revised merger agreement will be entered into, and a definitive settlement agreement will be executed, subject to court approval.

Intek, each of its directors and Securicor consistently have denied any wrongdoing. They agreed to settle to eliminate the burden and expense of further litigation and to permit the tender offer and the merger to proceed without risk of injunctive or other relief, an Intek spokesperson said.

Among allegations made in one lawsuit naming Richard F. Sequeira and three others as plaintiffs were the following:

- Intek management refused to meet with financial analysts and refused offers from brokers to promote the stock to institutions.
- The defendants failed to publish in any meaningful way any substantive forecasts of revenue, earnings, cash flow projections, licensing and royalty income and other positive business developments.
- Intek has developed much improved technology over its current linear modulation (LM) technology but failed to effectively market or promote it.
- The company failed to announce that its Nokia licensing deal had been modified, increasing licensing fees to be paid to Intek.
- John Simmonds, Intek's former chief executive officer, who owned about 10% of the company's stock, is in financial trouble and has dumped large portions of his stock into the open market. The current board has done nothing to stem such selling or to avert its detrimental impact on the trading of the shares, the lawsuit alleges.

Simmonds said: "We weren't the culprits driving the price of the stock down. We sold out our entire block of stock in October 1998 to European banker Mees Pierson as part of a debt settlement. We had a financial problem because we had borrowed $10 million or $12 million against our $35 million asset—Intek stock—and then the stock went almost to zero. When the stock went below $2, we had a problem with the banker. We settled by giving them the stock and other consideration. We have no financial problem now."

- The company has entered into a deal with Northrup Grumman, Los Angeles, to provide LM technology for radar defense systems. The lawsuit alleges that Intek Chairman Robert J. Shiver privately characterized the deal as "enormous" for the company in terms of potential profits. The lawsuit states that the deal was to have been publicly announced by March 10, 1999, but that there has been no such announcement.
- The lawsuit further claims that Shiver said in a private conversation that the company could be cash-flow-positive in two months if he wanted to run it that way and, in any event, Intek would turn cash-flow-positive no later than December 1999.

The tender offer, which commenced June 16, was extended to Aug. 16, 1999. As of July 30, 12 million shares of Intek common stock had been validly tendered and not withdrawn pursuant to the tender offer. On June 7, 16 million shares were outstanding that were not already owned by affiliates of Securicor. At least half of the outstanding shares must be tendered for the offer to succeed.

If the merger is completed, Intek may have to pay the plaintiffs' attorneys and the attorneys' financial advisor fees amounting to as much as $1.4 million. Payment depends on application to the court and subsequent court approval. Four plaintiffs, Richard F. Sequeira, Kenneth J. Anderson, James E. Ryan and William Goodwin, will be paid $10,000 each out of the fees. *DB*

UTC changes name, elects officers at 1999 conference in Nashville, TN

As more than 150 telecommunications companies exhibited their wares at UTC Telecom '99 in Nashville, TN, the conference's host voted to change its name. Formerly UTC, the Utility Telecommunications Association, it is now the United Telecom Council.

The change came after a vote by the UTC membership on June 28 to update the association's name to better reflect its recent expansion of services.

UTC Chairman Charles Holcomb said the change "will reflect our commitment to being the telecommunications and information technology trade association for utilities, pipelines and other critical infrastructure companies, and all their partners."

The association's name wasn't the only thing to undergo an overhaul at the conference. The UTC elected a new slate of officers to its board of directors. Holcomb stepped down and introduced Stephen Carrico as the new chairman of the association. Carrico will continue on as the director of communications business development for Wisconsin Public Service in Green Bay, WI. Mike Cross took over as the new vice chairman, and Carol Gittinger was voted the new secretary treasurer.

UTC Telecom '99, which took place at the Opryland Hotel Convention Center, offered several educational sessions, including pre-conference tutorials on the basics of telecom, post-conference workshops on joint-use management and Y2K contingency planning. Linda Breathitt of the Federal Energy Regulatory Commission delivered the keynote address. *MH*

FCC Notes

Commission proposes medical telemetry service

Medical telemetry equipment is close to receiving its own spectrum band on a blanket-licensed, interference-protected basis. Currently, the equipment operates on a secondary basis and is subject to interference. The FCC's proposal would allocate spectrum and establish rules for a wireless medical telemetry service. The move came after a recommendation submitted recently by the American Hospital Association's Medical Telemetry Task Force that addresses the potential safety risks to patients from interference to wireless telemetry equipment. Medical telemetry equipment allows health care workers to remotely monitor recently discharged patients.

U.S. telecommunications nears Year 2000 readiness

In its quarterly report to the FCC, the Network Reliability and Interoperability Council (NRIC) announced that the industry is expected to achieve Year 2000 readiness by late in the third quarter, 1999. As of June 1999, approximately 99% of the switches in the U.S. public switched telephone network (PSTN), owned by local carriers, were Y2K-ready. In addition, the NRIC reported that major interexchange carrier switches were virtually 100% Y2K-ready in April.

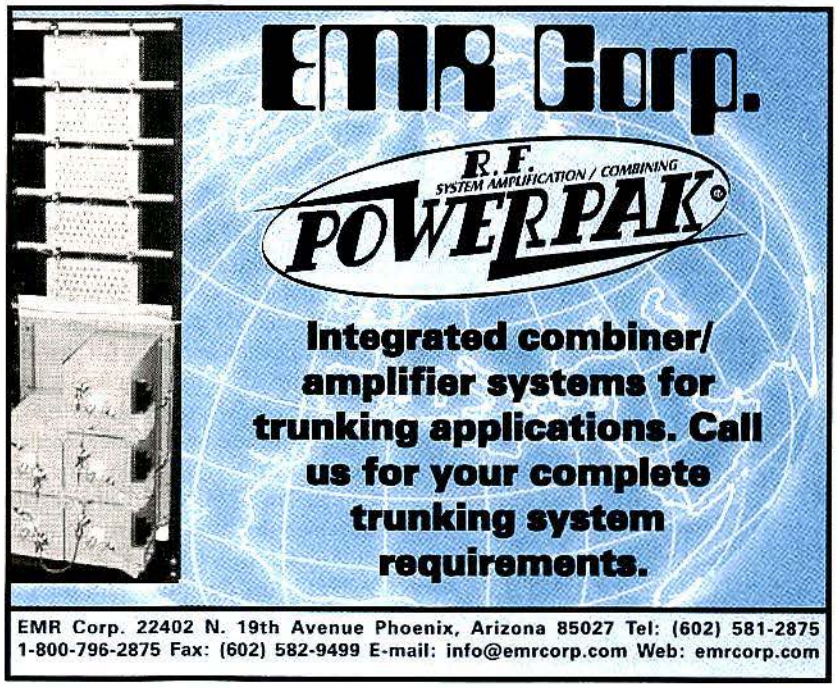
FCC set to auction spectrum bands in 2001

The FCC began adopting rules to permit new services on spectrum bands formerly designated exclusively for UHF TV service. The 746MHz–764MHz and 776MHz–794MHz bands are set to be auctioned for commercial purposes after Jan. 1, 2001. This move comes as a result of the Balanced Budget Act of 1997, which called for the reallocation of this 36MHz of spectrum. The spectrum became available because of the Commission's efforts to free up channels 60–69 for new users as part of the transition to DTV. Current UHF licensees operating on these channels will be permitted to continue interference-free operations until the deadline for conversion to DTV.

—Matt Halverson

JPS Communications receives $3.6 million grant

JPS Communications has been awarded a $3.6 million purchase grant from the U.S. Department of Justice to furnish communications interoperability systems to 12 U.S. cities. These systems use the company's ACU-1000 Modular Interconnect. They overcome a shortcoming in emergency response caused by the inability of public service agencies, such as fire, police and SWAT teams, to communicate with each other. The ACU-1000 allows existing radio networks at different frequencies to cross-connect with each other and with telephone and cellphone networks. The systems are being purchased by the U.S. government under an anti-terrorism initiative and furnished to the cities free of charge. The Department of Justice systems will be manufactured at the company's facility in Raleigh, North Carolina.



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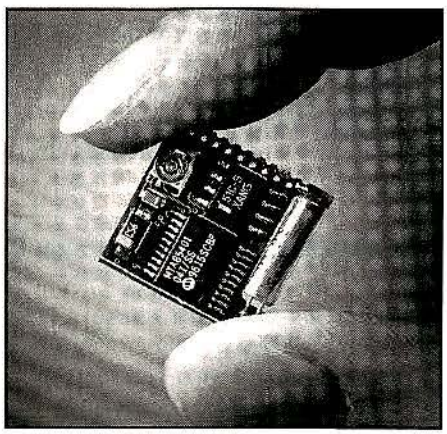

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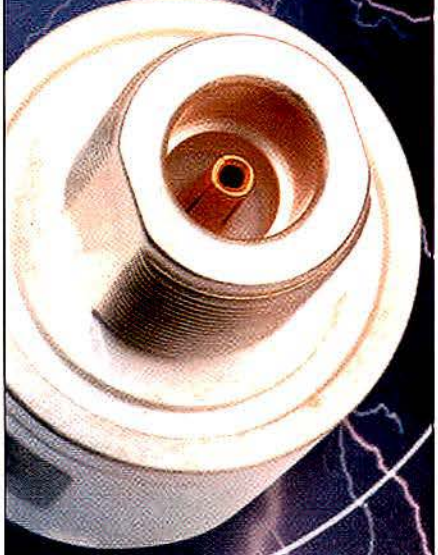

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Harris, U.S. Cellular agree to contract extension

With their 10-year partnership close to ending, Harris, Redwood Shores, CA, and U.S. Cellular, Chicago, signed a $20 million three-year contract extension on July 6 for the supply and installation of Harris radio links

As part of the agreement, U.S. Cellular will use several models of Harris microwave radios to replace its leased T1 lines, update existing microwave equipment and expand service to rural markets without existing cellular providers. Harris is expected to put its new digital microwave radio Constellation to use in these areas to increase traffic carrying capacity and facilitate growth of U.S. Cellular's subscriber base, currently estimated at 2.3 million.

"In this immensely competitive market, the cellular companies that thrive are the ones that can bring services to market the fastest," said Richard Goehring, U.S. Cellular's executive vice president of engineering. "Harris has enabled us to meet our aggressive rollout schedules."

The agreement also stipulates that Harris will train U.S. Cellular employees, facilitating the company's move to microwave networks and making it possible for it to meet its goal of supplying rural and medium-sized markets.

Richard Peabody, general manager of Harris' Microwave Communications division, said, "This partnership will allow us to continue providing cellular capabilities to communities that would otherwise have limited access to wireless service."

Oklahoma city selects Global Dispatch software

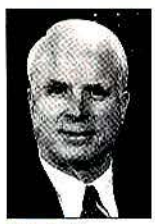
The city of Chickasha, OK, has selected Global Dispatch's CAD Assist as the software to manage its dispatch center.

Chickasha's police department provides dispatch services for law enforcement, fire and emergency medical services. The new communications center will be outfitted with new dispatch technology that will make it easier for Chickasha's police and fire departments to lessen the time required to respond to emergencies.

Until this development, the communications center had manually dispatched 25,000 calls annually using an older DOS-based records program. Through federal programs and grants, the city of Chickasha can fund the upgrade from the manual system to a Windows NT-based, Y2K-compliant CAD system that has the ability to grow with the community.

Robert Hicks, Chickasha's chief of police, said, "This upgrade is just a stepping stone for Chickasha's police and fire departments. In the future, we also want to install mobile data terminals using Global Positioning Systems in all vehicles for even more accurate and efficient emergency response team dispatching. CAD Assist's ability to integrate with new technology will allow us to seamlessly integrate MDT and GPS into our dispatch operation."

Sen. John McCain to speak at SBT conference



McCain

Sen. John McCain (R-AZ), chairman of the U.S. Senate Commerce Committee and a candidate for the Republican nomination for president, will deliver the keynote speech at the Small Business in Telecommunications (SBT) National Conference on October 14 and 15.

SBT, a trade association that focuses on regulation and legislation that affect small business, is holding its annual conference at the Regal River Front Hotel & Convention Center in St. Louis.

Along with the paid conference registration package, attendees will receive a copy of McCain's upcoming book and an opportunity for him to sign it.

Chadmoore acquires licenses from American

Chadmoore Wireless Group, Las Vegas, has agreed to acquire 16 10-channel 900MHz wide-area licenses and customers in seven metropolitan trading areas (MTA) covering a population of more than 18 million. Chadmoore will assume American Wireless' note payments to the FCC for these licenses and will lease all related equipment for six years.

Robert Moore, Chadmoore's chairman, said, "We see these acquisitions as adding to our long-term growth opportunities in the covered markets. These licenses already provide service to hundreds of customers, and we plan to aggressively begin to increase loading as soon as possible."

Southern LINC licenses UP.Link server

In response to the growing demand for wireless technology, Southern LINC has taken the first steps in giving its customers increased access to wireless data and to the Internet. The Atlanta–based service from Southern Company licensed Phone.com's UP.Link server on July 14 to bolster its wireless data infrastructure.

Southern LINC intends to use the UP.Link server to offer a suite of wireless data and Internet services on Motorola IDEN handsets, which run the Phone.com Wireless Application Protocol (WAP)-compatible UP.Browser microbrowser.

The Up.Link server will add services such as email, stock quotes and news updates to Southern LINC's current offerings of two-way radio service, phone service and text, and numeric paging.

Dawson

"With the combined technology, businesses will have real-time access to information that will help them increase productivity, maximize efficiency and enhance customer service," said Bob Dawson, president of Southern LINC.

The UP.Link server enables Southern LINC to provide customers in such industries as construction, field service and transportation access to applications designed to monitor the location of vehicles, manage work orders and track job flow.

This announcement came on the heels of an agreement Southern LINC reached with eDispatch.com on April 14 to deploy the company's wireless Internet data system to its customers. eDispatch.com's service enables Southern LINC users to manage, support and track mobile workers.

Air Liquide Canada, Vancouver, B.C., has joined Southern LINC as a subscriber to eDispatch.com's wireless Internet services. Air Liqiude began using eDispatch's resources in March to automate the dispatch and operations management of its delivery fleet in Vancouver, B.C.

Customers may place orders over the phone with Air Liquide, and with the new service, these orders can be dispatched over the Internet to drivers. Using phones equipped with a keypad and screen, drivers can receive customer information and report back on order status.

Hewlett-Packard realigns, forms new company

Hewlett-Packard has completed its plan to strategically realign itself into two independent companies. Agilent, the new company, consists of what used to be HP's measurement and components business. Agilent is already a prominent provider of test and measurement equipment and communications components. The company's products and services serve markets that include communications, electronics, life sciences, healthcare and semiconductors. The company contributed nearly $8 billion in revenues to HP during the company's fiscal year 1998.

Agilent is being formed from HP's automated test group, communications solutions group, electronics product and solutions group, chemical analysis group, healthcare solutions group and the semiconductor products group.

The computer and imaging businesses will retain the HP company name.

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News Notes

The **AG Communication Systems** subsidiary of **Lucent Technologies** and **Glenayre Technologies,** Charlotte, NC, have entered a joint marketing, research and development agreement to provide a next-generation Intelligent Network-grade applications platform for the prepaid services market. "The introduction of AG Communication Systems' network expertise and Service Control Point technology into the Glenayre Intelligis product line represents a key investment in the future for Glenayre and our customers," said **Terry Kraft**, general manager and vice president, Intelligis openMEDIA, Glenayre Integrated Network Group. "This product offers the next phase of network evolution, allowing network operators flexibility in choosing their solutions that have been joined via open standards-based Intelligent Network technology." (www.glenayre.com, www.agcs.com)

Lagorio Communications, Manteca, CA, has acquired **Maple Leaf Communications** and **Maple Leaf Wireless**, both of Bakersfield, CA. "The Maple Leaf communications system on Mt. McKittrick will extend and enhance our existing wireless network," said owner **Kathleen Lagorio Janssen.** (www.lagorio.com)

Janssen

Lowell, MA-based **M/A-COM**, a unit of **Tyco International** subsidiary **AMP**, will deploy its OpenSky Wireless IP Network as part of Pennsylvania's new statewide public safety digital radio system. "No other state has a comprehensive statewide public safety radio system to rival this new network," said **Thomas G. Paese**, secretary of administration for the state. **Juergen Gromer**, president of AMP, added, "This is a great opportunity for M/A-COM and AMP together in the systems business, particularly for wireless communications." M/A-COM Vice President **John Vaughan** said, "Pennsylvania literally broke new ground in their expectations for a public safety communications network."

Paese

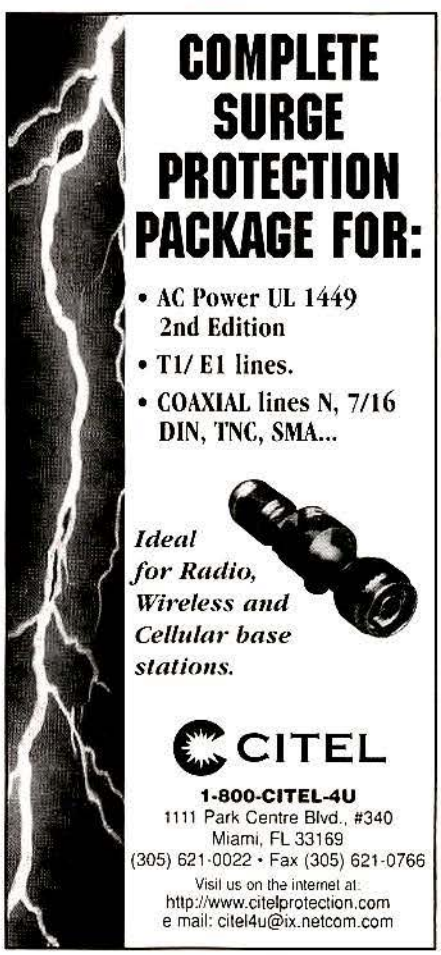
Vaughan

Fibrebond's 210,000-square-foot Minden, LA, production plant began operation in June, replacing the company's 15-year-old plant that burned to the ground on Sept. 20, 1998. "With the start-up of production in the new $7.5 million facility, Fibrebond now has the two most modern concrete processing plants in North America," said **Jeff Burford**, company president. The company has a somewhat larger plant in Fairfield, CA, that uses the same processing equipment. ... **Sprint PCS,** Overland Park, KS, has awarded **Berkeley Varitronics Systems,** Metuchen, NJ, a contract for 12 wireless telecommunications test systems comprised of receivers and transmitters for microcell analysis. **World Access,** Alpharetta, GA, has purchased eight of Berkeley's Gator transmitters.

Ness

President Clinton has nominated **Susan Ness** to a second term as an FCC commissioner, subject to Senate approval. A Clinton appointee, Ness was sworn in as a commissioner in 1994 and is now the most senior of the commissioners.

Circle (48) on Fast Fact Card



Circle (51) on Fast Fact Card
Visit us at PCS '99, Booth #3609

Pagers

Alert monitor scans two channels

The Minitor III from **Telepath** is an alert monitor receiver designed for the fire and emergency medical services. The alert monitor receiver can scan two channels and has tone and vibrating alerts. It can support as many as six calls per channel, allowing individuals to be members of different teams. The receiver is also built to hold up in tough environments and is protected against dust, water and other contaminants. This programmable unit is available for immediate delivery.

Circle (351) on Fast Fact Card

Device offers information updates

Motorola's Jazz word message pager measures 2.9" × 1.49" × 0.78" and is available in a variety of colors. Created by designers to be stylish and easy to use, the message pager offers a range of functions. The pager is equipped with a one-line scrolling display and a 2,200-character memory. It works as a message manager, receiving and storing as many as 16 personal messages, and comes with three information updates, such as stock quotes, news or sports.

Circle (353) on Fast Fact Card

Database contains 5,000 pagers

Canamex Communications' Quickpager wireless system is offered with a 1W, 2W or 5W, crystal-controlled or synthesized UHF or VHF transmitter. It includes a POGSAG encoder for paging to alphanumeric, numeric and tone/vibrate pagers. The system has an internal 5,000-pager database and uses smart voice prompts to receive pages from any touch-tone phone. You can also program an internal 200-name directory. The system also has an internal modem to send messages to paging or PCS text phone companies or to receive messages from other remote entry devices. (www.canamexcom.com)

Circle (354) on Fast Fact Card

Pager features 72-character display, 20-message storage

Visiplex's Vision four-line alphanumeric pager features a 72-character display, 20-message storage with POCSAG and 512bps/1,200bps/2,400bps switchable signal speeds. The pager also has four ID addresses, protection for 12 messages and message time-stamping. The pager also features four alarm settings, five selectable alerts and silent vibration. Specifications include 440MHz–470MHz and 150MHz–174MHz frequency ranges, 7μV/M paging sensitivity, 25kHz channel spacing and >60db selectivity.

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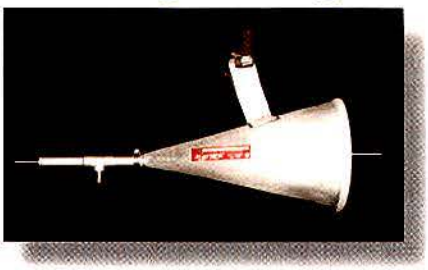
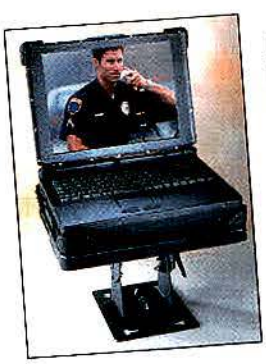
Antenna system offers in-building coverage



Radwire from **Rubytron** is a distributed antenna system designed to provide in-building wireless coverage. This product enhances wireless coverage inside high-rise buildings, transportation terminals, shopping malls, campuses, warehouses and manufacturing facilities. Radwire replaces radiating coaxial cable, standard coaxial cable and individual antennas with a single-wire transmission line that serves as a high-efficiency distributed antenna. Radwire can be installed in drop ceilings, cable risers, airshafts, corridors, tunnels, perimeter walls and outdoors. A y-branch splitter allows the wire to be branched at the surface-wave level. The system is band-specific, entirely passive and rated for plenum environments. Available systems cover the cellular/SMR/paging, DCS, PCS and 2.4GHz ISM bands.

Circle (401) on Fast Fact Card

Notebook comes with wireless modem



Amrel Systems' Rocky rugged notebooks provide mobile workers with wireless access to data in a notebook computer. The computers are MIL-STD-810 C and E-rated for shock, vibration, temperature, humidity, rain, marine, fog and altitude changes. The line is equipped with the Expedite wireless IP modem, which transmits wireless data at up to 19.2kbps. The Expedite modem is four times smaller than its predecessor at 5mm × 54mm × 73mm.

Circle (402) on Fast Fact Card

READERS' CHOICE

Of the new products in the February 1999 issue, this one generated the biggest reader response. For more information on this product, circle the corresponding Fast Fact Card number on the card found in the back of this issue, and mail the card to us.

Public safety mobile features MDT, AVL

Kenwood's TK790/890 mobile is designed for use in public safety vehicles. The 160-channel, VHF/UHF heavy-duty radio passes MIL-SPEC 810 C, D and E, as well as the MIL-STD for driven rain. The mobile is versatile with many software and hardware options, including MDT and AVL, and it is remote ready. In a vehicle, it can be used as a single-head remote mount, and it can be configured as a dual-band remote mount. With the number of head and mounting options, any variation can be designed for a particular installation. The unit has a 14-character, alphanumeric LCD. Other features include dynamic grouping, 14 programmable controls and a complete set of emergency features.

Circle (500) on Fast Fact Card

Controller allows longer length alpha pages

Kantronics Paging Controller 2000 version 4.0 allows alpha pages received in TNPP format to be up to 1,024 characters in length, with a separate maximum length for "local" and "area-wide" pages, based on TNPP source address. Pages can be rejected outright based on TNPP source address; local pages can be given preference over area-wide pages based on TNPP addressing. When POCSAG or Golay pages are encoded for transmission, those given preference are taken first if they fit the current codeword slot. Golay encoding is added to the Kantronics 2000, with simulcasting, preferential transmissions and a Golay/POCSAG mix supported.

Circle (403) on Fast Fact Card

Control panel offers remote, local monitoring

The SSD3 system status and control panel from **Power Conversion Products** offers remote and local monitoring of the dc power system (rectifiers, battery and power distribution board) and provides local and remote status and alarm conditions as well as some control functions. Remote access is via a built-in phone line modem or RS-232 port. Control actions are limited to setting alarm levels, activating single or dual low-voltage disconnects and automatic call-back via phone line. The SSD3 is compatible with Twinpack Plus and PS-23 dc power systems containing as many as 100 rectifiers for all signals except temperature-compensated battery charging and remote shutdown.

Circle (404) on Fast Fact Card

Analyzer offers 0.5ppm frequency accuracy

The model 9052 PC-based spectrum analyzer from **Morrow Technologies** can be installed in a standard PC chassis with 16-bit ISA connectors. The 9052 uses fully synthesized digital tuning for swept frequency to 0.5ppm. An automatic test procedure feature stores test sequences that can be recalled for later use. Independent point markers simultaneously provide the absolute amplitude and frequency of two points. The 9052 also provides a complete overlay drawing capability.

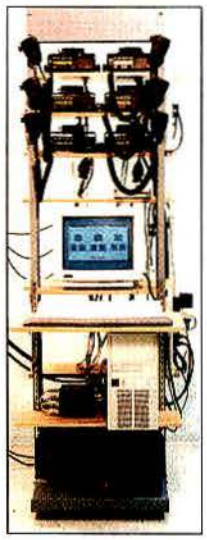
Circle (405) on Fast Fact Card

Digital radio camera stores nine images

The KVT-10 from **Kenwood Communications** is the company's newest model of digital radio camera, capable of sending images from one radio to another. This version has a custom-fitted, heavy-duty rubber boot to protect the camera's housing, making it suitable for outdoor use in public service, including police, fire, emergency and disaster management. The camera can store as many as nine digital images in JPEG format, connects directly to most popular models of portable radios and sends digital images to one or multiple recipients also equipped with a radio and KVT-10 unit. With its built-in mic and speaker, the camera can be used simultaneously for voice and image communications.

Circle (406) on Fast Fact Card

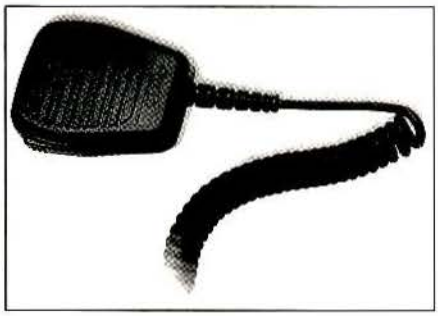
System supports 450MHz trunking



The Net-link MP for 450MHz UHF and LTR trunking systems is now available from **IDA**. The system provides multiple-customer, multiple-site and multiple-voice path dispatch linking along with simulcast capability. No phone lines, microwave or additional frequencies are needed. Using standard EF Johnson 9800 series mobiles as the linking backbone, the system can carry as many as three simultaneous conversations. The voice paths are trunked for maximum network capacity. No modifications to the end-user's mobile or hand-held radios are required. Linking lag time and lost words or syllables are eliminated by the use of Wordsaver digital audio delay.

Circle (421) on Fast Fact Card

Speaker mic offers watertight protection



The OTTO V2-L from **Otto Communications** is a sealed, watertight speaker microphone compatible with several radio makes and models. In addition to its ability to endure 40mph blowing rain, the V2-L is designed to meet MIL-STD-810E specs. It features a million-cycle push-to-talk switch and a heavy-duty cable assembly capable of withstanding 25,000 flex cycles. The mic's earphone jack accepts standard 2.5mm plugs, and its clothing clip rotates 360°, with click stops every 45°. The speaker microphone includes an integrated connector interface for major radio models.

Circle (407) on Fast Fact Card

Male connectors provide latitude in assembly

The RFD-1605-2 series of 7/16 DIN male connectors from **RF Connectors** are silver-plated, machined brass with Teflon insulation and combination head configuration. The ferrule stud backnut gives the user the ability to decide at the time of assembly whether to create a straight or right-angle crimp connector. The cable center conductor can be soldered through either the side or the end opening of the connector body. The 7/16 DIN connectors feature silver-plated inner and outer contacts to minimize intermodulation distortion. Jumper cable assemblies, featuring male and female 7/16 DIN connectors on a variety of coaxial cables, are available in standard and custom lengths.

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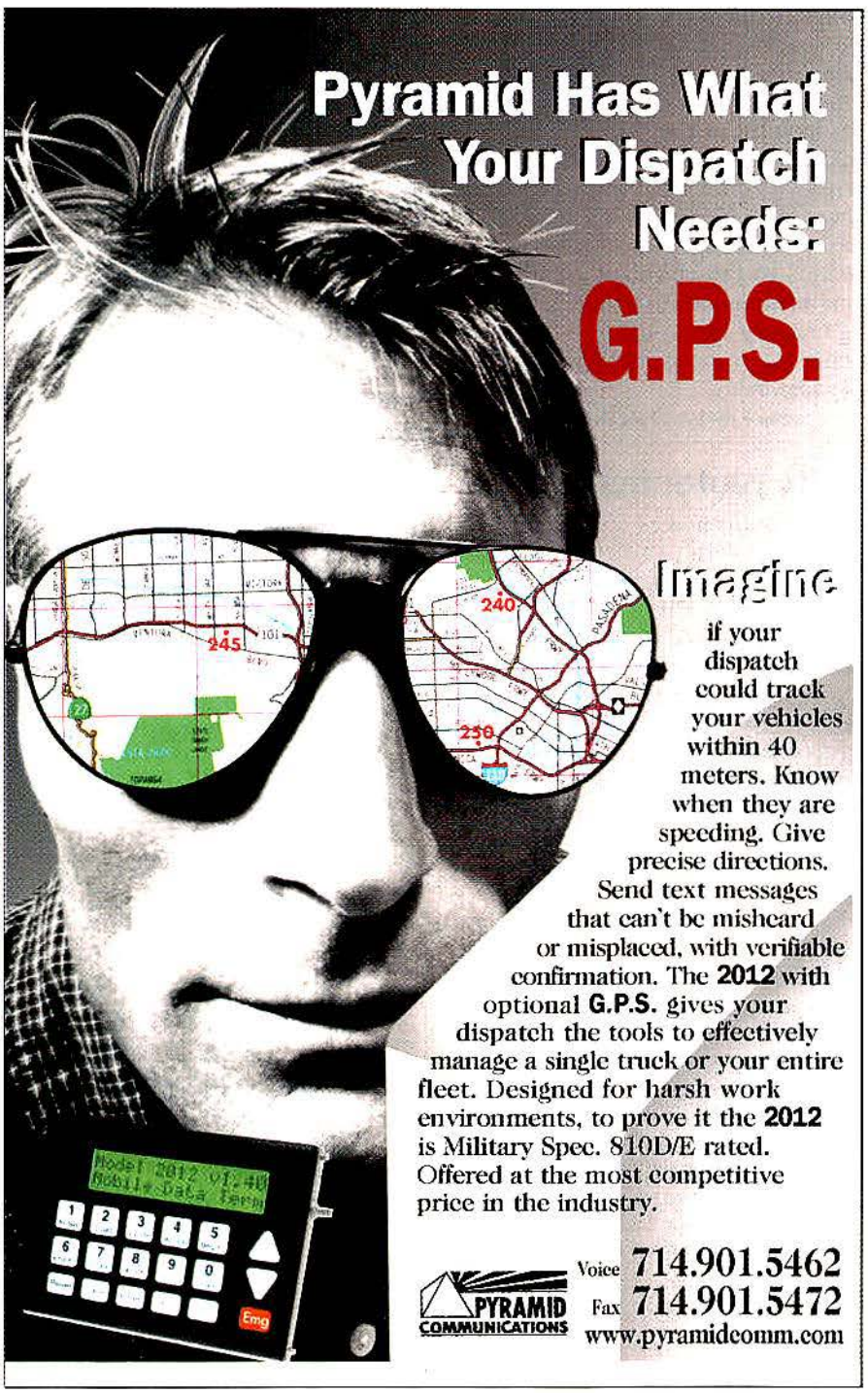
Circle (50) on Fast Fact Card

Yagi antennas feature five welded elements

The BMOY series of yagi antennas from **Maxrad** features five welded elements, 9dB gain and an enclosed feed network with a type N female connector at the boom end. This new design can ease installation and can enhance the antenna's durability and performance, while providing full protection from severe weather conditions. Each BMOY antenna series comprises three wideband models that cover the entire UHF and 800MHz and 900MHz bands, reducing total inventory requirements. The UHF series includes three models: model BMOY4065 for 406MHz–440MHz, 4405 for 440MHz–480MHz and 4705 for 470MHz–512MHz. The 800MHz and 900MHz series includes model BMOY8065 for 806MHz–866MHz, 8245 for 824MHz–896MHz and 8705 for 870MHz–960MHz. All models feature a black-powder-coated finish for added durability and come complete with mounting hardware that allows positioning for horizontal or vertical polarization.

Circle (409) on Fast Fact Card



Circle (57) on Fast Fact Card

Mount offers ball & socket design

Gamber-Johnson's R-A-M mounting system features the universal ball-and-socket design. The products are made of marine-grade aluminum with a black-powder-coated finish, stainless steel hardware and injection molded rubber balls. The system features wide ranging holding capacity. The rubber balls can be tightened to slight distortion, preventing any slipping or loosening. Or, for safety concerns, they can be tightened just enough to hold for typical use, while allowing for breakaway movement under increased force.

Circle (410) on Fast Fact Card

Amplifier achieves 30km transmission

Multipoint Communications' Amp2400 is a bi-directional RF amplifier-dc injector used for achieving as far as 30km line-of-sight wireless transmission of any short-range radio modem or broadcast device. By inserting the amplifier between the directional antenna and the radio modem, both the transmit power and receive sensitivity can be improved by 10dB to 30dB.

Circle (411) on Fast Fact Card

Connectors improve signal-to-noise ratio

Triaxial connectors and cable assemblies from **Tru-Connector** are for use where low- and high-level RF signals are transmitted simultaneously through cables that are bundled or located in high-energy fields caused by radar or transmitters. The Triax connectors are compatible with 50V triaxial cables used in applications requiring the reduction of noise radiation or cross-talk with an improvement in the signal-to-noise ratio. The weatherproof connectors can be supplied as plugs, jacks, receptacles, caps and adapters in Triax-C, Triax-N, BNC, TNC and other sizes. The connectors conform to MIL-C-4912 specifications for noise-free guarded systems.

Circle (412) on Fast Fact Card

Reflectometer aids twisted-pair technicians

The model 3300 rugged, hand-held, metallic, time-domain reflectometer from **Riser-Bond Instruments** is designed to help technicians and installers locate faults in any twisted-pair application. The waveform TDR tests for opens, shorts, sheath faults, broken or loose conductors, load coils, bridged taps and water damage. Dual connectors allow for display and comparison of two live pairs or of stored and live waveforms. High-energy, rechargeable batteries keep the TDR instantly ready for service calls.

Circle (413) on Fast Fact Card

UHF antenna works with Motorola mount

The 450MHz UHF version of the Lopro antenna from **Northpoint Communication Products** is compatible with any standard ¾" Motorola-type mount. The mount assembly and the spring-loaded contact pin are made of brass. A nitrile O-ring seated in the base provides a waterproof seal. It withstands temperatures from –65° to +180°F and has compression set, cold flow, tear and abrasion-resistance characteristics.

Circle (414) on Fast Fact Card

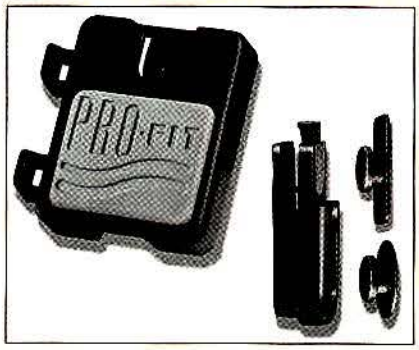
Battery pack fits Kenwood radios

The CNB17A model battery pack from **Centurion International** is designed to fit Kenwood Communications models TK-280/380, TK-290/390 and TK-480/481 radios. The NiCd battery is rated at 7.2V and 1,500mAh. A replacement for some of the newest Kenwood portable radios, the CNB17A supercedes the Kenwood KNB17-A.

Circle (415) on Fast Fact Card

Compact holder allows one-hand operation

PRO-Fit International's Portable Solution is a compact holder for hand-held communications devices. It allows for one-hand operation when mounted in a vehicle. The holder can be used in vehicles and on belts with its multi-use button. The holder can be used with cellphones, PCS phones, two-way radios, hand-held GPS or personal digital assistants. The holder also comes with a built-in penholder and pen.



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Antenna and Cable

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Our commercial line of SWR instruments include: ***30-150 MHz, 140-525 MHz and 700-1000 MHz***. These quality products give a graphical presentation of the SWR and Return Loss curves for an antenna or tuned circuit under test. Each product includes Windows™ 95/98 applications for saving and printing curves. Each product is priced in the US at ***$599.95, $659.95, and $759.95*** respectively, plus $7.50 shipping and handling.

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The new *TR-3120 Step TDR* gives the user ***resolution to better than one inch***, with the ability to determine the ***impedance of any discontinuity*** including connectors and splices. Faults can be spotted in the first inch of cable out to about 4800 ft.

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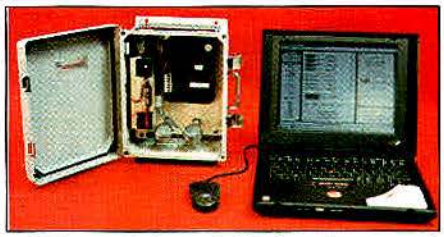
Circle (56) on Fast Fact Card

Data logger offers four analog channels



Telescada's ATS-8P data logger offers as many as four analog channels of electronic data logging with capacity to store as many as 13,000 records. It comes with a Windows-based data retrieval support program. Standard units are equipped with one or two pressure transducers that are deployed for monitoring gas pressure on natural gas distribution systems. Other types of transducers can be interfaced. Low energy consumption enables the logger to operate for years powered by a small integral solar cell. The logger is housed in a small NEMA 4/12 high-impact strength, UV-resistant fiberglass-reinforced polyester enclosure.

Circle (417) on Fast Fact Card

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Antenna supports ESMR systems

Celwave's Super Stationmaster broadband omni-directional antennas, the A08410M series, are for SMR and ESMR systems. With 10dB gain and coverage of the entire frequency range, the antennas allow duplex operations on a single high-gain antenna. Optional 3° electrical tilt contributes to improved signal control, and the center-feed design eliminates beam swing across the band. The antennas' triple-wrapped, heavy-duty fiberglass construction protects radiating elements, assures less tip deflection and withstands winds as high as 230 miles per hour.

Circle (418) on Fast Fact Card

Paging system offers alphanumeric capability

Zetron's Pagecenter paging communications system for on-site applications complements the Zetron paging system product line. The system allows a person to initiate pages from the numeric keypad, RS-232/TAP, telephones, alarms and DTMF hand-held radios. The system offers full alphanumeric paging capability with expanded address capability. Other features include group calling and an integrated two-way radio (136MHz–174MHz, 260MHz–280MHz and 403MHz–512MHz) with 2W/4W output.

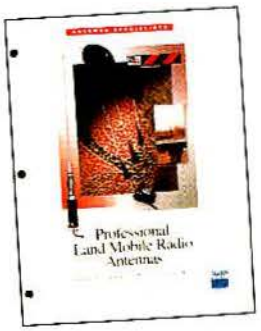
Circle (419) on Fast Fact Card

CDPD modem works with most laptops

The Data 2000 from **Uniden Multimedia** is a battery-powered, portable, CDPD modem that works with most laptops, sub-notebooks or hand-held computers that use Microsoft Windows 98, 95, NT and CE operating systems. The Data 2000 makes it possible for laptop users to retrieve email, connect to the Internet and send faxes while out of the office.

Circle (420) on Fast Fact Card

Catalog focuses on antennas



Antenna Specialists' *1999 Professional Land Mobile Radio Antenna Catalog* features updates on current low-band, VHF and UHF antennas, as well as special-purpose, hand-held portable and general mobile antennas. It also features the new springless Mosaic antenna series. Featured LMR antennas include the full range of the Mosaic series with the Duraflex elastomer spring for noise elimination; quarterwave "Chrome-Dome" antennas for less rugged applications; and patented "On-glass" technology that requires no ground plane.

Circle (451) on Fast Fact Card

Resource guide offers benefits

Jensen Tools' updated version of the *Communication Products Resource Guide* offers a range of toolkits, specialty tools, diagnostics and service aids for cableTV, data, wireless and audio visual alarm communications industries. It also includes several new products. Jensen offers same-day shipping, a 30-day unconditional guarantee, a lifetime guarantee on all Jensen brand hand tools, free technical support and a complete online catalog with secure ordering at www.jensentools.com.

Circle (452) on Fast Fact Card

Application note solves debugging

Hewlett-Packard's new application note helps designers solve common debugging problems using HP logic analyzers. The 13-page note, *Eight Hints for Solving Common Debugging Problems with Your Logic Analyzer*, provides information for hardware engineers, firmware designers and systems integraters. It covers such topics as acquiring data from a multiplexed address or data bus, using offsets to avoid false triggers, reducing security risks on networked logic analyzers, capturing data before a system crash and analyzing serial data with a logic analyzer.

Circle (453) on Fast Fact Card

Report analyzes wireless industry

The Strategis Group's *Financial Benchmarks in the U.S. Wireless Industry: 1998* provides a comprehensive look at the financial health of the cellular, PCS, paging and ESMR markets. For each sector, Strategis indentifies financial indicators, tracks them from 1994 through mid-year 1998, analyzes them in relation to subscribers and other financial data, and provides financial projections. Numerous charts and graphs provide a reference for wireless industry financial analysis. Detailed analysis of individual company financials for a cross-section of cellular, PCS, paging and ESMR companies is included in the 300-page report, as well as in-depth financial models developed by The Strategis Group. Analysis and trends are presented on revenues, expenses, EBITDA, debt and capital expenditures, cash flow and subscriber growth.

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CD-ROM features data sheets

Wheelock's comprehensive CD-ROM includes data sheets on fire-alarm notification, commercial audio, security, telephone and industrial signaling, and ULC products and systems. Potter Electric Signal Sprinkler and Security Devices data sheets are also included. The CD contains the Nactool notification appliance circuit design tool and the new Nacevac Safepath audio, fire and emergency evacuation system design tool. These Windows-based programs are designed to assist system designers, application engineers and technicians in the layout and design of notification appliance circuits and Safepath evacuation systems.

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Site offers engineering software

Comsearch's Web site, www.comsearchonline.com, offers engineering software and data products for designing wireless networks. Comsearch Online will help in designing wireless networks by providing customers with quick and efficient access to engineering services, GIS products (including morphology and building databases), as well as technical and administrative information for wireless systems. The Web site allows users to initially purchase engineering software, FiveNines and 1arc second-digitized terrain data.

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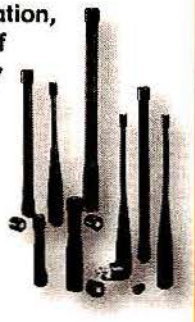

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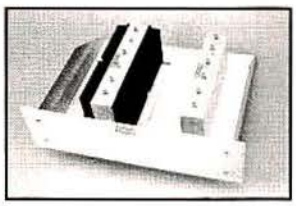

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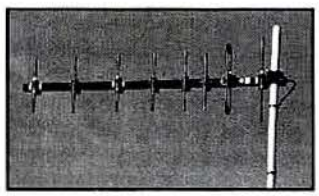

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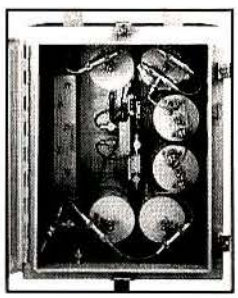

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people


Lyon


Trimble


Cullens


Rogers

Jill Lyon, vice president for regulatory relations at the American Mobile Telecommunications Association, Washington, advances to president for regulatory relations and deputy general counsel.

Charles Trimble, founder of Trimble Navigation, Sunnyvale, CA, assumes position on the board of directors for KVH Industries, Middletown, RI.

E. Van Cullens, president of the communications sector at Harris, Melbourne, CA, moves up to president of the company.

Richard Rogers, manager of AMREP marketing at Amplifier Research, Souderton, PA, advances to vice president of the company.

Robert Batten, sales and marketing manager for Teletec, Wake Forest, NC, joins Davicom Technologies, Raleigh, NC, as national sales manager-USA.

John T. Nakahata departs the FCC, Washington, as chief of staff to become a partner at Harris, Wiltshire & Grannis.

Joan Wathen leaves Wholesale Wireless Business Services, SNET Mobility, New Haven, CT, as vice president to join KSI, Annandale, VA, as vice president of marketing.

Dominick Arcuri, technical marketing manager at Ericsson Private Radio Systems, Lynchburg, VA, advances to vice president of engineering.

Changes at Crown Castle Atlantic, Pittsburgh:

Jim Donahue assumes the position of vice president of the Eastern New England region. **Bob Ackerman** advances to vice president of the New England West region. **Tod Bettenhausen**, vice president of business development becomes vice president of eastern Pennsylvania/New Jersey/Delaware. **Varinia Paige** moves from the real estate/development business in the Washington Metropolitan region to vice president for the Washington and Baltimore area. **Brian Fovel**, general manager from RCC Atlantic Long Distance, becomes vice president for North and South Carolina. **Larry Hughes** departs Cellular One's southwest operations as director of engineering to become vice president of the Southwest Region.

Changes at Narda Microwave-East, Hauppauge, NY:

Michael J. Sanator, director of operations, advances to vice president of operations. **Robert A. Koelzer**, previously product line manager for passive products, becomes vice president of engineering.

Davidi Gilo, chairmain of the board of DSP Communications, Cupertino, CA, assumes the position of CEO.

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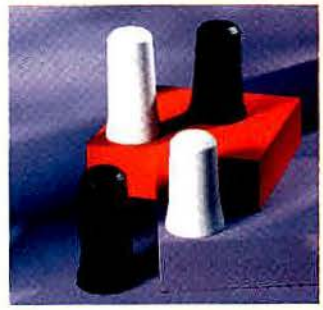

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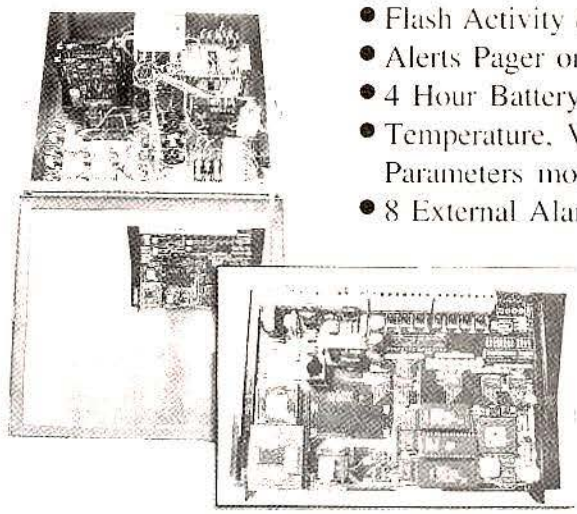

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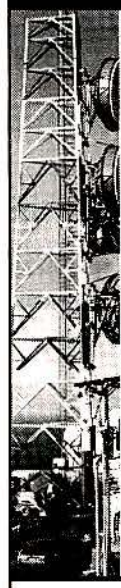

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AeroComm, Inc.	45	38	201-227-0066
Air Comm	69	114	602-275-4505
AMI-Applied Micrologic Inc.	72	112	817-568-8550
Anritsu Company	17	14	800-ANRITSU
Antenex	68	103	800-323-3757
Astron Corp	7	7	949-458-7277
Barnett Electronics Inc.	68	102	800-423-3858
BatteryPRO Systems, Inc.	34	27	403-933-5393
Berkeley Varitronics	51	43	732-548-3737
Canamex Communications Corp	62	52	800-387-4237
Chase Systems	30	25	973-252-6605
Citel America, Inc	56	51	305-621-0022
Communications Data Services	77	125	800-441-0034
Communications Specialists	BC	3	800-854-0547
Computer Resources Inc.	76	124	205-987-1523
Comtelco Incustries, Inc.	71	107	800-634-4622
Connect Systems, Inc.	19	15	800-545-1349
Consumer Electronics Show	47	58	703-907-7628
Control Signal Corp.	53	45	800-521-2203
CPI Communications Inc.	56	48	800-869-9128
CTI Products, Inc.	74	118	513-595-5900
Daniels Electronics	50	42	250-382-8268
Dapa Communications, Inc.	5	6	716-373-7228
Davicom Technologies	41	34	877-327-4832
Diversified Electronics	62	53	800-646-7278
Doppler Systems, Inc.	38	32	480-488-9755
DX Radio Systems	24	18	877-439-7234
Eagle Wireless International	37	30	281-538-6000
EDX Engineering, Inc.	27	21	541-345-0019
EF Johnson	1	4	800-388-1912
EML, Inc.	71	109	615-771-2560
EPCOM	70	106	915-533-5119
EMR Corp.	53	44	602-581-2875
GAI-TRONICS Corp.	55	47	888-254-9155
The Genesis Group	77	128	903-561-6673
Hark Systems, Inc.	46	39	800-367-4275
Hark Systems, Inc.	74	120	800-367-4275
Hewlett Packard	43	36	800-452-4844
Hutton Communications	29	24	877-648-8866
ICT	35	28	604-888-6304
IFR Systems, Inc./RF Division	25	19	800-835-2352
International Cellular Telephone	74	119	305-640-2424
IWCE 2000	14-15	12	303-741-2901
Klein Electronics	73	115	760-631-2811
Larsen Electronics	73	117	800-426-1656
Leavitt Communications, Inc.	79	131	800-870-3686
Maha Communications	71	110	714-985-9132
Maxrad, Inc.	20	16	800-323-9122
McManus Communications	8-9	8	870-763-6250
Mechem Electronics	70	104	540-891-0569
Mobile County Electronics	72	111	334-633-4030
Motorola Test Equipment	11	9	800-422-4210
Multiplier Industries Corp.	51	34	914-241-9510
Narda/L3 Communications	IBC	2	516-231-1700
New Hampshire Communications	72	101	603-668-3004
PageTek, Inc.	78	130	919-518-1828
Paging & Wireless Service Center	41	35	800-822-2180
Paniks Electronics-N-Surplus	73	132	407-253-0889
Penta Corporation	28	22	504-733-1700
Pirod, Inc.	49	41	800-748-3817
Polaris Industries	75	121	404-872-0722
Polyphaser Corp.	54	46	800-325-7170
Premier Communications	44	37	714-257-0300
Procomm	75	122	805-497-2397
Pyramid Communications	60	57	714-901-5462
Radio Express, Inc.	72	113	703-631-1365
Radiomate	39	33	800-346-6442
RCC Consultants	65	100	732-404-2400
RCW Distributing	70	105	612-808-0069
RF Imaging & Communications	69	116	925-229-2034
RFS Cablewave Systems	31	26	800-437-3045
SCA, Inc.	59	50	800-627-4722
Simulcast Solutions	71	108	716-223-4927
SMC	57	49	800-527-1079
Softwright	77	127	303-344-5486
Southwest Windpower	38	31	520-779-9463
Survey Technologies, Inc.	77	126	503-848-8500
Swager Communications	78	129	800-968-5601
Tait Electronics USA, Inc.	26	20	800-222-1255
Telepath	63	54	800-292-1700
Telewave, Inc.	64	55	800-331-3396
Thunder Eagle	28	23	888-877-8022
Trident Micro Systems	16	13	800-798-7881
TX RX Systems Inc.	3	5	716-549-4700
Vega	12	10	402-467-5321
VERTEX/YAESU USA	IFC	1	562-404-2700
Vocom Products Co. LLC	49	40	847-593-1213
WETEC	76	123	901-286-6275
W & W Manufacturing	13	11	800-221-0732
Zetron Inc.	36	29	425-820-6363

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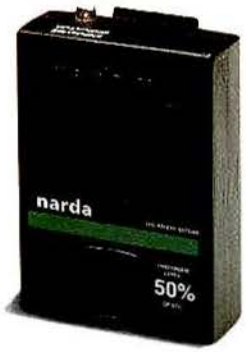

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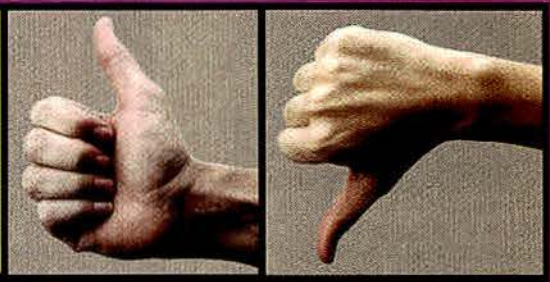
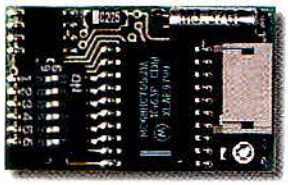
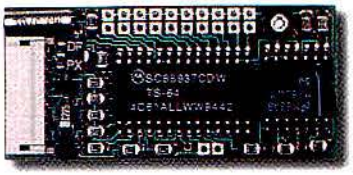


	Narda	Competition
Frequency Range	300 kHz-45 GHz	3MHz-40 GHz
Frequency Response Error	*Guaranteed* Max. ± 2 dB	Not Guaranteed Typical ± 3 dB
Responds equally to all field polarizations	*Guaranteed* Max. ± 0.75 dB	Not Guaranteed Typical ± 2 dB
Accurate at all temperatures	*Guaranteed*	No
Immune to static	*Guaranteed*	No
RMS detection under all conditions	*Guaranteed*	No
Functions near power lines	*Yes*	No
LED Indicator visible when worn on body	*Yes*	No
Unit cost	*$*	$$$
2 Year factory calibration & checkup included*	*Free (No calibration costs for 4 years)*	$
Calibration within 10 business days	*Guaranteed (or calibration is Free)*	No

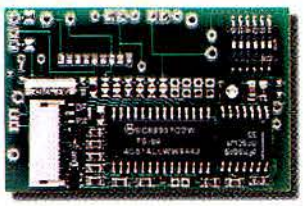
*Two-year recommended calibration cycle. No additional costs for four years with first two-year checkup and calibration included.



SS-64 $28.95
Microminiature DIP Switch Programmable CTCSS Encoder.
Includes 64 tones from 33.0 to 254.1 Hz.
.66" x 1.08" x .21"



TS-64 $54.95
Sub-miniature Programmable CTCSS Encoder-Decoder.
Includes 64 tones from 33.0 to 254.1 Hz.
.78" x 1.70" x .25"



TS-64DS $57.95
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Includes 64 tones from 33.0 to 254.1 Hz.
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ANI-1/$39.95 **ANI-2/$299.95**
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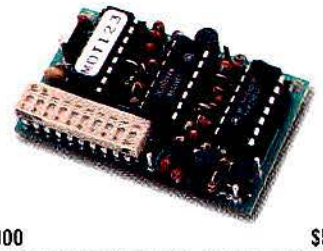
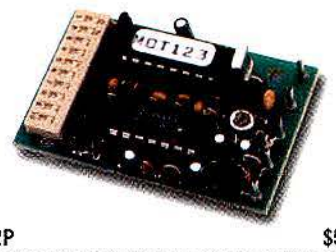


SD-1000 $59.95
Two-Tone Sequential Decoder. Programmable unit provides switched outputs from Two-Tone paging calls.
1.25" x 2.0" x .4"



PE-2P $54.95
Two-Tone Sequential Encoder. Sub-assembly mounts inside radio or other enclosure. Multiple call capability.
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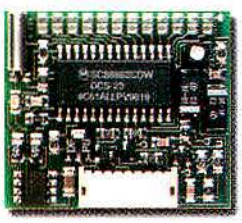

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